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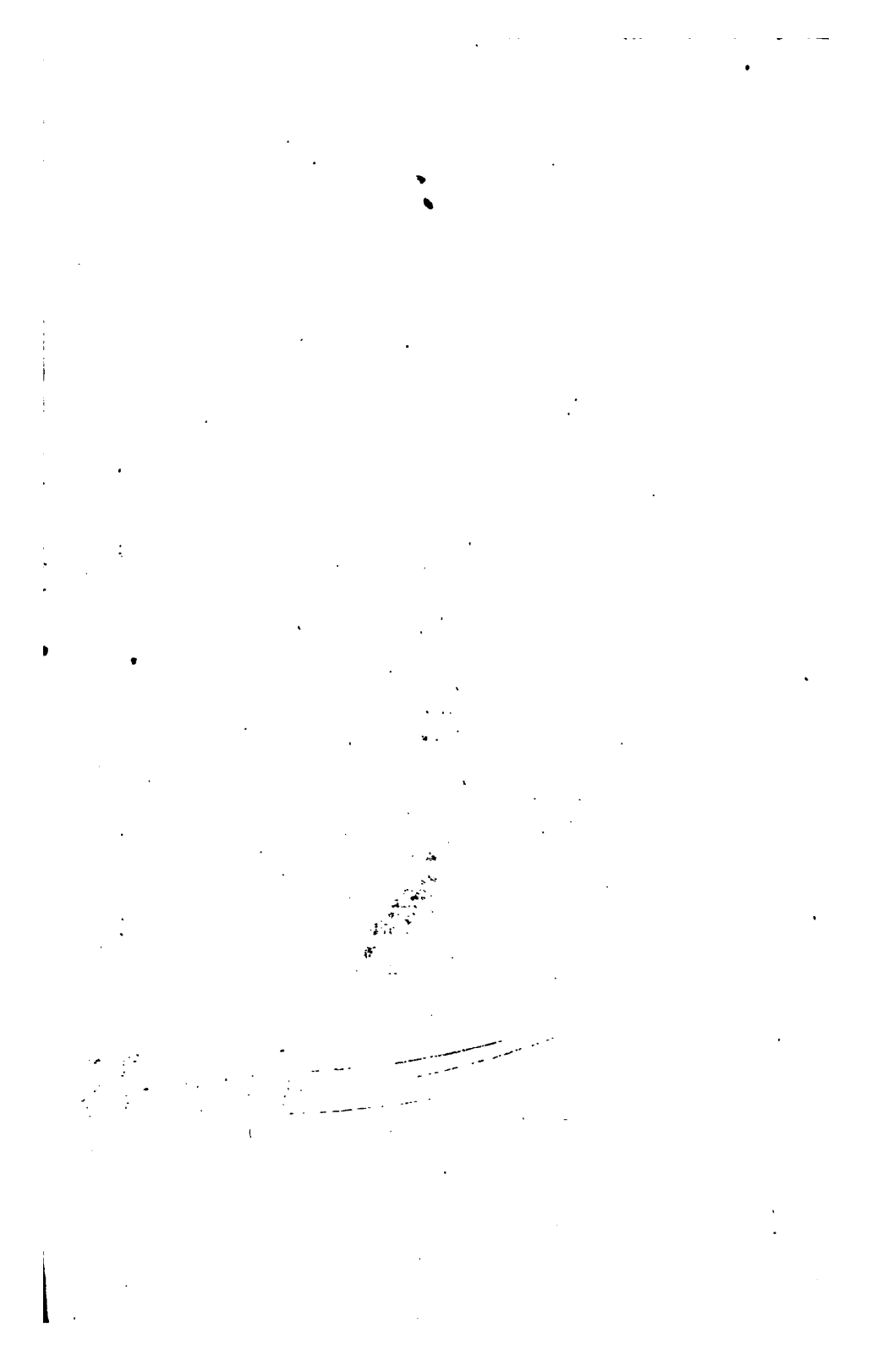

H. Gravin Delin.et sc. Sculpt. Edin.r

Pondere, mensura, numeris, mihi pervius orbis;
Hinc decus et vires, hinc pleno copia cornu.

THE

UNIVERSAL ACCOUNTANT

AND

COMPLETE MERCHANT.

IN TWO VOLUMES.

By WILLIAM GORDON,

of the ACADEMY, GLASGOW.

The third Edition, corrected, and revised by the AUTHOR.

VOLUME I.

Quid munus reipublicæ majus meliusve afferre possumus, quam si juventutem bene erudiamus? CICERO.

EDINBURGH:

Printed for ALEXANDER DONALDSON; and sold at his shop, corner of *Arundel street*, in the *Strand*, *London*: and at *Edinburgh*.

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TO

HIS GRACE,

ALEXANDER,

DUKE of GORDON.

MY LORD,

I HAVE the honour, once more, to approach your Grace, with a work originally intended to create, in the Britiſh youth, an ambition to excel in the practical arts of trade, which have ever been conſidered as the beſt ſupport of civil policy.

The protection of arts, and of thoſe who contribute to improve them, as it is the diſtinguiſhed province of the great, ſo, it ſeems to be, of your Grace, peculiarly characteriſtical: The whole nation, my Lord, early remarked your virtues, and, to open a larger field for their exertion, have called you into the Britiſh ſenate.

Whilſt your Grace's public character, as a patriot, as a liberal encourager and promoter of every uſeful and ornamental art, command our reſpect and admiration; your

amiable private virtues, as a huſband, father, friend, gain our ſtrongeſt attachment and eſteem.

Allow me, therefore, to congratulate my country, in having, at ſo early a period of life, a friend and benefactor ſo illuſtrious; and allow me, my Lord, at the ſame time, to expreſs, on this occaſion, my ſincere gratitude, and particular attachment to your Grace, for the ſingular obligations, which your goodneſs to me and my family has laid me under.

I have the honour to be, with the utmoſt ſubmiſſion and reſpect,

May it pleaſe your GRACE,

Your GRACE's moſt obedient,

Moſt obliged, and

Moſt humble ſervant,

WILLIAM GORDON.

To the PUBLIC.

WHOEVER conſiders the numberleſs tranſactions that diverſify the buſineſs of a merchant, muſt readily ſee, that a perfect knowledge in figures and accounts, a facility and conciſeneſs of operation, and ſome idea of trade in general, are neceſſary pre-requiſites to fit a gentleman with propriety for the counting-houſe, without which, he can be little more than a ſpectator, during all the courſe of his apprenticeſhip, however important and extenſive the buſineſs, and however great the ſkill and addreſs, with which he may ſee it conducted.

The plan of education uſually followed in ſchools, hath been by almoſt conſtant experience found to be far from anſwering the deſign; nor have former publications contributed ſo much as could have been wiſhed to ſupply that defect, the method of computation in all of them being too tedious and formal for buſineſs, and the plan of accountantſhip ſo defective and confined, and

and in many inſtances ſo confuſed and prolix, as to be altogether impracticable.

To remove this difficulty, which is one of the greateſt in the purſuit of buſineſs; to render mercantile computations intelligible, eaſy, and conciſe; to illuſtrate the method of arranging and adjuſting accounts of buſineſs, in a train of appoſite examples in every branch of trade, according to the practice of the moſt ingenious and experienced, were the prevailing motive of this undertaking: And the countenance with which two former impreſſions have been diſtinguiſhed, gives the author reaſon to conclude, that the execution hath been in ſome meaſure adequate to the deſign, that it will be of ſome importance in forming the Britiſh merchant, and enable many to purſue with pleaſure, what otherwiſe, perhaps, they might have but little reliſhed.

The method of conducting youth, previous to the counting-houſe, is ſo fully explained in the Eſſay on Education, and the obſervations in every rule ſo numerous and applicate, that there is no room for directions in this place. It may not however be improper to adviſe the reader, to make himſelf fully maſter of the elements, before he proceed to the application, other-

wiſe difficulties may occur, which will require frequent retroſpection, render ſtudy diſagreeable, and greatly retard his progreſs.

This edition will appear with advantages greatly ſuperior to the former. The Author's practice and converſation have enabled him to make many ſenſible additions, alterations and improvements, in almoſt every chapter of both volumes; having had it conſtantly in view, to merit, as far as poſſible, that favour wherewith the public hath honoured his work.

GLASGOW, February 12, 1770.

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By the Author, and proper Maſters.

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ON

The EDUCATION of a YOUNG GENTLEMAN intended for the COUNTING-HOUSE.

IT is a truth, which the ingenious writers of all ages have acknowledged, and conſtant experience has confirmed, that commerce contributes to the proſperity of ſtates, communities, and individuals, in proportion to the wiſdom of the laws and regulations upon which it is eſtabliſhed, the privileges by which it is encouraged, and the judgement and addreſs, wherewith it is conducted. Wiſe inſtitutions, and well-concerted bounties for promoting the intereſt of trade, are the happy effects of good government; and ſuch is the peculiar importance of an extenſive and well-regulated commerce to theſe kingdoms, that it is hoped it will ever be the object of our public care. But the beſt regulations, and the greateſt privileges, will ſignify little, unleſs they be rendered practical, operative, and uſeful, by the ſkill and addreſs of the judicious and induſtrious merchant. It is he who employs the poor, rewards the ingenious, encourages the induſtrious, interchanges the produce and manufactures of one country for thoſe of another; binds and links together, in one chain of intereſt, the univerſality of the human ſpecies; and thus becomes a bleſſing to mankind, a credit to his country, a ſource of affluence to all around him, his family, and himſelf. What extent of knowledge, what abilities muſt it require, to fit a man for ſo

great and valuable purpoſes? And yet it is certain, that there is not another claſs of men, in the Britiſh community, who labour under greater diſadvantages, in point of education, than that of the commercial profeſſion?

A few years are ſpent at the grammar-ſchool, and perhaps a few more at the univerſity; but ſo little time is allotted for the grammar-ſchool ſtudies, that few, very few, can carry from thence the knowledge or the judgement prerequiſite to univerſity-ſtudies; by which means a number of years is ſpent, and a conſiderable expenſe laid out, to very little purpoſe. Add to this, the low opinion that is generally entertained of the uſe of thoſe ſtudies among men of buſineſs; which, when it happens to be diſcovered by their children, deſtroys that emulation and ambition to excel, that ought to ſupport them in the elements of learning; and, in fine, induces them to conſider the whole as a formal drudgery impoſed on them by cuſtom, which continues only for four years.

At a certain age, not after certain acquiſitions, a teacher of figures and accounts is applied to; and, in this caſe, the cheapeſt market is often reckoned the beſt. When the round of this teacher's form is once finiſhed, the ſtudent is then turned over to the counting-houſe; where, if he is found qualified for nothing higher, which is too often the caſe, he will be employed, during the time of his apprenticeſhip, in copying letters, going meſſages, and waiting on the poſt-office.

The buſineſs of the counting-houſe is of ſuch importance, and every moment ſo precious to the maſter, that had he talents for communicating, he hath no time for attending to the inſtruction of an apprentice;

tice; who, on the other hand, hath been ſo little accuſtomed to think, that his improvement by ſelf-application will be very inconſiderable. Beſides, his time of life, and conſtant habit of indulgence, render him more ſuſceptible of pleaſurable impreſſions, than of improvement in buſineſs; the more eſpecially when he was not previouſly prepared to underſtand it. Wherefore it is not at all ſurpriſing, if many, who, having no foundation in knowledge to qualify them for the purpoſes of the counting-houſe, profit little from the expenſe and the time of an apprenticeſhip, and from ſeeing the moſt extenſive buſineſs conducted with all the ſkill and addreſs of the moſt accompliſhed merchant. The conſequence is, no doubt, fatal to numbers; and the public intereſt, as well as private, muſt ſuffer greatly by every inſtance of this nature. It muſt indeed be acknowledged, that there have been, and ſtill are, gentlemen, who deſtitute of all previous mercantile inſtruction, without money and without friends, by the uncommon ſtrength of natural abilities, ſupported only by their own indefatigable induſtry and application, and perhaps favoured with an extraordinary ſeries of fortunate events, have acquired great eſtates. But ſuch inſtances are rare, and rather to be admired than imitated. For we have likewiſe ſeen many go through all the forms mentioned above, ſet out with large capitals, though perhaps without any other mercantile accompliſhment but an adventurous ſpirit, who have ſhone in the commercial world, while their capitals laſted, as meteors do in the natural; but, like them, ſoon deſtroyed themſelves, and involved in their ruin all ſuch who were unhappy enough to lie within the

ſphere of their influence *. Commerce is not a game of chance, but a ſcience; in which he who is moſt ſkilled bids faireſt for ſucceſs; whereas the man who ſhoots at random, and leaves the direction to fortune, may go miſerably wide of the mark. Parents ought by no means to truſt the future proſpects of their children in the world to a foundation ſo weak or uncertain; and, indeed, it is not reaſonable to expect, that the moſt ſubſtantial character in the Britiſh community can be formed from an education which is common even to the meaneſt citizen.

There never was a time when the neceſſity of a reformation in this particular was greater, or promiſed more ample rewards.——When Britain, by the force of her arms, hath opened, in all quarters of the world, a paſſage for an unlimited commerce, which the wiſdom of her councils hath eſtabliſhed and ſecured by a glorious peace;—when unanimity, formerly unknown, freedom, peace, and proſperity, will give new vigour to the polite arts;—when our neighbours, the French, who have long been our rivals in commerce, will ſtrain every nerve to recover by their trade what they have loſt by the war;—when the low intereſt of money, and the extent of our dominions abroad, will induce many people of fortune to ſtrike into trade, by which means the ſtores abroad will be multiplied, and many more hands employed;—it is hoped a few thoughts on the education of a merchant, will neither be unſeaſonable nor unacceptable.

* Novimus novitios quoſdam, qui cum ſe mercaturæ vix dederunt, in magnis mercimoniis ſe implicantes, rem ſuam male geſſiſſe; et profecto imperitos mercatores, multis captionibus ſuppoſitos, multorumque inſidiis expoſitos, experientia videmus. *St. de mercat.*

To

To be able to read the Engliſh language with ſome eaſe and accuracy, is certainly prerequiſite to every other ſtudy; and it is with pleaſure that we ſee daily improvements made in this particular. Men of education have not been aſhamed of late to take upon them the direction of children in reading Engliſh, which, but a few years ago, was committed to people of very little knowledge. This is a reformation, which, as it was very much wanted, ought to be particularly encouraged and promoted; although, at the ſame time, the purpoſes of it ſhould by no means be extended, eſpecially by thoſe of rank and fortune, beyond its real bounds. It is imagined by ſome, who have reaped little benefit from three or four years attendance at a grammar-ſchool, that the new method of teaching Engliſh will anſwer all the purpoſes intended by the ſtudy of dead languages to a man of buſineſs. But this opinion is ill-founded. The ſtudy of the Engliſh language is not yet carried to a proper extent; and if it was, it would ſtill fall ſhort of the purpoſes of a liberal education. There is no buſineſs whatever that requires a greater correſpondence, or a diction more pointed and conciſe, than that of the merchant; and it would require a ſingular ſtrength of genius to write even correctly in the Engliſh language, unleſs a foundation in the Greek and Latin languages had been previouſly laid. The arts and ſciences, by theſe means, are laid open to us, the moſt ingenious of all ages become our companions and acquaintances, whom we may upon all occaſions with freedom conſult.

The mind muſt be prepared and opened by degrees; and before we know the grammar which reſpects the genius of our own language, we muſt go back

back to the ſource for the principles of which it is compoſed. The Roman language never arrived at its greateſt perfection till it called in the aſſiſtance of the Greek; and ours would have been void of force and harmony without the aid of both. Beſides, no period of life is ſo apt for proper impreſſions, as the years allotted for the grammar-ſchool; and no leſſons furniſh more excellent examples of correct writing and regular living, than what are contained in the claſſics, if they are properly attended to, and judiciouſly improved. It is here, where youth are furniſhed with the firſt opportunity of paſſing a proper judgement on what they read, with regard to language, thoughts, reflections, principles, and facts, without which the knowledge of words would be very inſignificant. How apt are young people, unleſs the knowledge of true criticiſm be properly laid, to admire and imitate the bright more than the ſolid, the marvellous more than the true, and what is external and adventitious more than perſonal merit and good ſenſe? And is it not of ſome importance, that youth ſhould be ſet to rights in particulars ſo eſſential? It is here where the taſte for writing and living may be in ſome meaſure formed, the judgement rectified, the firſt principles of honour and equity inſtilled, the love of virtue and abhorrence of vice excited in the mind, provided the grammar-ſchool ſtudies be properly directed, and carefully purſued. *Quare ergo liberalibus ſtudiis filios erudimus? non quia virtutem dare poſſunt, ſed quia animum ad accipiendam virtutem præparant. Quemadmodum prima illa, ut antiqui vocabant, literatura, per quam pueris elementa traduntur, non docet liberales artes, ſed mox percipiendis locum parat; ſic liberales artes non perducunt animum ad virtutem, ſed expediunt.*

The

The ſtudy of rhetoric and compoſition ought by no means to be neglected by a young gentleman intended for the counting-room. This will give him an opportunity of reducing to practice, what formerly he had been only taught to reliſh. It will not only teach, but accuſtom him to range his thoughts, arguments, and proofs, in a proper order, and to clothe them in that dreſs which circumſtances render moſt natural. By this means he will not only be able to read the works of the beſt authors with taſte and propriety, but be taught to obſerve the elegance, juſtneſs, force, and delicacy of the turns and expreſſions, and ſtill more, the truth and ſolidity of the thoughts. Hereby will the connection, diſpoſition, force, and gradation of the different proofs of a diſcourſe be obvious and familiar to him, while at the ſame time he is led by degrees to ſpeak and write with that freedom and elegance, which in any other way will be found very difficult to attain.

But to ſpeak or write well, however neceſſary it may be, is not the only object of mercantile inſtruction. It will be of little conſequence to have the underſtanding improved, if the heart be totally neglected. Man was made by nature for ſociety, but the merchant both by nature and practice; who, if he is not qualified or not diſpoſed to act his part well, like a bad performer in a concert of muſic, will deſtroy the harmony, and render the whole diſagreeable. Therefore, to tune his mind to virtue and morality, to teach him to blend ſelf-love with benevolence, to moderate his paſſions, and to ſubject his actions to the teſt of reaſon, he muſt have recourſe to philoſophy.

The principles of law and government ought likewiſe to conſtitute a part of the mercantile plan of inſtruction;

ſtruction; by which we are taught to whom obedience is due, for what it is paid, and in what degree it may be juſtly required: more particularly in Britain, where we profeſs to obey the prince according to the laws; and indeed we ourſelves are ſecondary legiſlators, ſince we give conſent, by repreſentatives, to all the laws by which we are bound, and have a right to petition the great council of the nation, when we find they are deliberating upon any act, which we think will be detrimental to the intereſt of the community, with reſpect to commerce, or any other privilege whatever.

When a young man hath been thus accuſtomed to application, reaſon, and reflection; when his taſte hath been formed, and his judgement confirmed; the ſtudy of thoſe ſciences which more immediately reſpect the counting-houſe, will become eaſy and agreeable; but it is neceſſary his teachers ſhould keep up the ſame ſpirit and dignity in their inſtructions with which his earlier ſtudies were animated, otherwiſe the deſign of the whole may be in danger of being fruſtrated.

The firſt care of a ſcholar, who is put under the tuition of a new maſter, is, to obſerve, to ſtudy, and to ſound him; and it generelly holds, that the proficiency of the one, and the authority of the other, are both in proportion to the judgement which the ſcholar forms of his maſter's prudence and abilities; for which reaſon, parents cannot be too ſtrict in their inquiries concerning the temper, qualifications, and character of a maſter, before they truſt him with ſo important a charge as the happineſs and proſperity of their children during the whole courſe of their lives.

Writing, the elements of arithmetic, and the

French language, ſhould, I think, be the firſt objects of inſtruction, when a young man is ſent to an academy, to be prepared for the counting-houſe; and theſe ought to be taught at particular hours on the ſame day. It is neceſſary that a young man commence the ſtudy of the French language early, that he may be able not only to tranſlate, but ſpeak and write the language with eaſe, before he enters the counting-houſe.

Writing is a prerequiſite to every other ſtep; and therefore no time ſhould be loſt in making him as ſoon and as much maſter of the pen as poſſible. To teach arithmetic well, which is another leading ſtep, requires more ſkill and knowledge than perhaps is attended to. It is, of all other ſciences, the moſt neceſſary to the mercantile profeſſion; and it is not a little ſurpriſing that it ſhould by ſo many be ſo ſhamefully neglected. Before arithmetic is applied to computations in buſineſs, the powers, properties, and relations of numbers ſhould be particularly taught and explained. Every rule ſhould be demonſtrated, exemplified, and illuſtrated in an eaſy and intelligible manner; and the examples ſo multiplied and diverſified, that the learner may be thoroughly grounded, and have a reaſon always ready for what he doth; all the various compendiums which ſerve to abbreviate operations, ſhould be diſtinctly ſhown and demonſtrated that facility and diſpatch may be equally familiar. When he hath thus become maſter of the capital rules in vulgar and decimal arithmetic, involution and evolution, he ought then to be introduced to geometry and algebra, which of all other ſtudies contribute moſt to invigorate the mind, to free it from prejudice, credulity, and ſuperſtition, and to

accuſtom it to attention, and to cloſe and demonſtrative reaſoning. In the courſe of theſe ſtudies, he ſhould be taught a new demonſtration of all his arithmetical rules; and the whole theory ought to be reduced to practice, in the menſuration of ſurfaces and ſolids, heights and diſtances, and in conſtructing the inſtruments he hath occaſion to uſe.——When practice is thus joined to demonſtration, the ſtudy of the ſciences becomes eaſy, entertaining, and inſtructive: whereas, were a young man to hear nothing elſe but demonſtration, he would ſoon be wearied of that kind of ſtudy, and conſider it as very dry and inſipid: but when he ſees the uſe of mathematics, in laying down plans and maps of countries, ſelling land by meaſure, aſcertaining the price of labour, and determining the quantity of liquors for a regulation of their price and duty, he muſt be convinced of their influence, and admire their excellency. To complete his mathematical courſe, he ſhould be made acquainted with navigation and geography. The firſt, after ſuch a general acquaintance with the mathematics, will require no great ſtudy: but to the laſt more time and reading will be abſolutely neceſſary.

The ſolution of a few problems on the globe, and three or four ſtudied harangues, will come far ſhort of anſwering the deſign. A teacher who conſiders the extent of geography neceſſary to a merchant, muſt ſee that the knowledge of the globes is no more than the elements of what he ſhould be inſtructed in. He muſt be made acquainted with the uſe of maps, the ſituation, extent, produce, manufactures, commerce, ports, politics, and regulations, with reſpect to trade, of all the nations in the world, not only by public lectures, but by private reading and converſation.

tion. This will not be the work of a few days or a month; and thoſe who allot no more time for geography, know very little of the ſubject. Half an hour every day for ſix months together ſpent in private inſtruction and examination, will perhaps be found little enough for a ſtudy ſo extenſive and important.

When the foundation is thus properly laid by ſuch a mathematical courſe as I have been deſcribing, communicated in that demonſtrative and practical manner, which will join ſcience with judgement, and conviction with experience; the counting-houſe muſt begin to open, and the *arcana mercatorum* be expoſed to view. Arithmetic muſt again be reſumed, and the former theory reduced to practice, in all the caſes which can occur to the merchant, the banker, the cuſtom-houſe, and inſurance office; to which every obſervation ought to be joined, which will ſerve to illuſtrate the uſe of the different examples in that particular branch of buſineſs to which they may be applicable. A proper courſe of reading at this period, which might be wonderfully improved by the converſation of a good maſter, upon the ſubjects of inſurance, factorage, exchange, and ſuch other branches of buſineſs, will be of ſingular uſe, not only to form the mind to buſineſs, but, when he comes to act for himſelf, to prevent many tedious and expenſive pleas, which an ignorance in the practical arts of negotiating them is frequently apt to create.

To this courſe of reading, an epiſtolary correſpondence among the ſtudents themſelves might, with great propriety, be added; as it would give them the practice of folding letters in a quick and dexterous manner, accuſtom them to digeſt well whatever

they read, and improve their diction, under the correction of an accurate maſter, to that clear, pointed, and conciſe manner of writing which ought peculiarly to diſtinguiſh a merchant. Fictitious differences among merchants might likewiſe be ſubmitted to their judgement, ſometimes to two in the way of arbitration, and again to a jury of fifteen; whilſt one would aſſume the character of the plaintiff, and another that of the defendant, and each give in ſuch memorials or repreſentations, according to the nature of the facts condeſcended on, as he thinks moſt proper to ſupport the cauſe, the patronage of which was aſſigned him. Thus will youth be accuſtomed to think, write, and act like men before they come upon the real ſtage of action; and their appearance in real life, will have nothing of that awkward and ſtupid manner which is generally obſerved in young men for ſome time after they enter the counting-houſe.

When a young man hath thus attained to a proper accuracy and diſpatch in figuring, and ſome idea of the different branches of buſineſs with which every kind of computation is connected; it is time then to introduce the young merchant to book-keeping, which is the laſt, but not the leaſt important branch of education previous to the counting-houſe. It is become a proverb in Holland, that the man who fails, did not underſtand accounts. And indeed, however much a merchant, who is concerned in an extenſive trade, may be employed in matters of a higher nature, and upon that account be neceſſitated to make uſe of the aſſiſtance of others in keeping his books, he ought certainly to be capable of keeping them himſelf; otherwiſe he never can be a judge, whether

whether juſtice is done him in that eſſential particular or not; neither can he have that idea of his own buſineſs, which is indiſpenſably neceſſary to the proſperity of his trade.

This happy method of arranging and adjuſting a merchant's tranſactions, muſt, like other ſciences, be communicated in a rational and demonſtrative manner, and not mechanically by rules depending on the memory only. The principles upon which the ſcience is founded, muſt likewiſe be reduced to practice by proper examples in foreign and domeſtic tranſactions: ſuch as, buying, ſelling, importing and exporting for proper, company, and commiſſion account; drawing on, remitting to; freighting and hiring out veſſels for different parts of the world; making inſurance and underwriting; and the various other articles that may be ſuppoſed to diverſify the buſineſs of the practical counting-houſe. The nature of all theſe tranſactions, and the manner of negotiating them, ought to be particularly explained as they occur; the forms of invoices and bills of ſales, together with the nature of all intermediate accounts, which may be made uſe of to anſwer particular purpoſes, ought to be laid open; and the forms of all ſuch writs as may be ſuppoſed to have been connected with the tranſactions in the waſte-book, ſhould be rendered ſo familiar, that the young merchant may be able to make them out at once without the aſſiſtance of copies.

As the following work is intended to be a complete courſe of mercantile computations and accountantſhip, to ſay more on the method of communicating them would be unneceſſary. Only I would beg leave to hint, that there are many things, the knowledge of

of which is better inculcated by public lectures, private reading and converſation, than in the ordinary method of teaching, when, perhaps, there may be two or more claſſes to direct. The national commerce in general; the trade of the place where we live; the laws, cuſtoms, and uſages relative to the buſineſs of a merchant, the penalties to which he is liable, and the privileges to which he is entitled; the duties, impoſts, and other charges laid upon the Britiſh produce in other countries, with all the known maxims that relate to the proſperity of trade; will open a wide field for improvement in matters of real uſe to the maſter as well as the ſtudent.

When the education of a young gentleman is thus conducted, from his earlieſt years, in a manner calculated to engage his mind in the love of uſeful knowledge; to improve his underſtanding; to form his taſte, and ripen his judgement; to fix him in the habit of thinking, ſteadineſs, and attention; to promote his addreſs and penetration, and raiſe his ambition to excel in his particular province; will not the tranſition to the counting-houſe be extremely eaſy and agreeable? His knowledge will be ſo particular; and his morals ſo ſecured, that he will be proof againſt the arts of the deceitful, the ſnares of the diſingenuous, and the temptations of the wicked. He will, in a ſhort time, be ſo expert in every part of the buſineſs of the practical counting-houſe, and be able to form ſuch a judgement of every thing he ſees tranſacted, that when he comes to act for himſelf, every advantage in trade will lie open to him: his knowledge, ſkill, and addreſs will carry him through all obſtacles to his advancement; his talents will ſupply the place of a large capital; and when the beaten track

of

of buſineſs becomes leſs advantageous, by being in too many hands, he will ſtrike out new paths for himſelf, and thus bring a balance of wealth, not only to himſelf, but to the community with which he is connected, by branches of trade unknown before.

How few are there, even among parents, who, perhaps, have felt the loſs of a proper education in their own practice, that conſider the extent of knowledge requiſite to make a young gentleman appear with dignity in the commercial life? and how few are there among thoſe who profeſs to qualify young gentlemen for the counting-houſe, that have knowledge in any degree proportionable to their credit? The reaſon is obvious: In every other article of expenſe, conſidered as communities or individuals, we are generally profuſe: but in that which relates to education, we are ſhamefully narrow. This falſe parſimony, this miſtaken frugality, prevents men of genius and education from appearing as teachers, becauſe their talents will turn out to much more account, in almoſt any other profeſſion whatever; and if circumſtances ſhould have rendered it neceſſary for a man of ſome abilities to turn his mind this way, he is obliged to divide his ſtudies among ſo many different ſciences and his time among ſo many different claſſes, to ſecure to himſelf a bare ſubſiſtence, that he hath neither the leiſure, the means, nor the opportunity of that reading or converſation, which is abſolutely neceſſary to his practice, in inſtructing youth in the moſt difficult and important branch of Britiſh literature. And if this is the caſe with the ableſt teachers, what can be expected of thoſe who became teachers becauſe they were really qualified for nothing elſe?

For

For the inſtruction of youth in every other ſcience, we have not only excellent inſtitutions, but eminent maſters, whoſe abilities are inquired into and approved of, before they are admitted to the important truſt: but in this caſe, great pretenſions, which are generally taken upon the teacher's word, and low prices for the articles of education in his ſcheme, are credentials ſufficient to procure him buſineſs, though neither the teacher nor the ſtudents reap much advantage from it.

The art of managing and forming the mind is perhaps of all others the moſt intricate and extraordinary, and certainly the moſt important; which, that it may be ſufficiently ſtudied, ought to be properly rewarded. It is no doubt the buſineſs of magiſtrates, to intereſt themſelves in the education of youth, ſince they are the nurſery of the ſtate, by whom it is renewed and perpetuated, and upon whom the national proſperity, as well as the national exiſtence depends. If part of the public revenues were employed in erecting academies for training up youth to buſineſs, eſpecially in trading cities, where every maſter ſhould have a ſalary proportioned to the difficulty of his department; if the moſt intelligent merchants were appointed as ſuperintendants of theſe academies, who would take care that none ſhould be admitted as ſtudents, whoſe proficiency in the languages, rhetoric, and philoſophy was not previouſly inquired into, nor any ſuffered to proſecute the ſtudies prerequiſite to the counting-houſe, whoſe genius was not in ſome meaſure turned to act with dignity in the mercantile profeſſion; if theſe gentlemen would inquire often into the morals and proficiency of the ſtudents, converſe frequently with the maſters on the ſubject of

trade, and admit the ſtudents according to their ſeniority in letters to ſuch converſations, and, in ſhort, take every other method of encouraging both maſters and ſtudents to induſtry and attention, that they might go through the tedious, the difficult taſk with alacrity and ſpirit; if parents, at the ſame time, would ſet that value upon education which they ſometimes do upon trifles, and be but as careful in having the minds of their children adorned with virtue and good ſenſe, as they are in ſetting off every thing which relates to their bodies, we would then ſee a reformation indeed. Were this to be the caſe, our youth would be long acquainted with the arts of gaining before they would learn how to ſpend money, and they would not be grown old in debauchery and riot, before they were initiated into buſineſs. Were this to be the caſe, we would ſoon ſee a ſpirit of induſtry, knowledge, humanity, and good ſenſe diffuſe itſelf among all ranks and denominations, whilſt idleneſs and folly with all their miſchievous train, would be baniſhed the ſtreets. In one word, our teachers would be men of underſtanding, our young men would be ſenators, and our "merchants would be princes."

THE

UNIVERSAL ACCOUNTANT.

PART I.

THE ELEMENTS OF ARITHMETIC.

INTRODUCTION.

ARITHMETIC is the art of reckoning by numbers, which, from the various combinations of these ten Arabian characters. 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, teacheth to calculate with expedition, exactness and ease.

To render operations more short and expressive, with great propriety have been introduced the following

CHARACTERS

The sign	signifies	read
+	Addition,	More.
−	Subtraction,	Less.
×	Multiplication,	Into.
÷	Division,	By.
=	Equality,	Equal to.
∷ ∷	Proportion,	As to. / So is.
⊐	Majority,	Greater than.
⊏	Minority,	Less than.
$\sqrt{2}$	Extraction of,	Square-root.
$\sqrt{3}$	Extraction of,	Cube-root.

It is not my present purpose, nor would it be material, to trace this useful art back to its original, or carry it through all the different steps of its improvement. The Lombards, no doubt, imported it into Britain; and, for its after improvements, we have been equally obliged to the productions and the practice of the ingenious.

CHAP. I. NUMERATION.

NUMERATION teacheth to read or write any number known, or propoſed.

RULE I.

To read any number, divide it by commas into claſſes of three characters each, beginning at the right-hand; over the right-hand figure of the third claſs, make a point; over that of the fifth, two points; over that of the ſeventh, three points, &c. The number to the left hand of the firſt comma, expreſs by thouſands; that which hath over it the firſt point, by millions; that which hath over it the ſecond, by billions; that which hath over it the third, by trillions, &c. The left-hand character of each claſs is expreſſed by hundreds, the middle one by tens, and the right-hand one by units.

RULE II.

To write down any propoſed number, reverſe the former rule; and, if any intermediate place is wanting, fill it up with the cipher (o). Upon theſe principles is effected the following table.

NUMERATION-TABLE.

1	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0				
1	6	8	7	9	5	4	3	2	1	6	8	7	9	5	4	3	2	1						

OBSERVATION.

It is obvious from the table, that all numbers increaſe in a decuple proportion; and, conſequently, that, in a ſeries of numbers, every figure hath a local, as well as ſimple value: hence ciphers, though they have no ſimple value, when annexed to ſignificant figures, remove thoſe figures ſo many ſteps from the units place, and increaſe their value accordingly.

CHAP. II. ADDITION of INTEGERS.

ADDITION teacheth to find a ſum which ſhall be equal to ſeveral homogeneous ones given.

RULE.

Place the numbers, each of the ſame local value under one another ſucceſſively; then, beginning with the loweſt, or units place, find the ſum thereof by collecting them all together, and, of that ſum, or total, write down under the column of units what belongs to that name, and carry the number of tens to be added with the next column, being the denomination to which, in the very nature of numbers, it belongs: of the ſum or total of the column of tens, write likewiſe down, under that column, the units place, whoſe value will be tens, and carry the tens to be added with their homogeneous column, which is hundreds. Proceed thus through the whole, and take down the ſum of the laſt column all together, there being no other to which it can be carried.

EXAMPLES.

(1.)	(2.)	(3.)	(4.)
75468	74367	478561	59374
37546	43243	37456	38
18764	67548	5937	473
34653	32764	5478	89
21687	13487	5684	9
85464	54728		45
273582	286137		

Illuſtration

Illuſtration of the firſt example

3+7=10+4=14+4=18+6=24+8=32 ; of which total, 2 belongs to the units column, and is accordingly taken down there ; the 3 in its local value is 30, or 3 tens ; therefore, 3+6+8+5+6+4+6=38 tens, or 380 ; of which total, 8 belongs to the place of tens, where it is taken down, and the 3, or 300, carried to be added with the column of hundreds ; thus, 3+4+6+6+7+5+4=35, or 3500 ; therefore 5 falls to be noted down in the place of hundreds, whilſt the 3 remains to be added with the column of thouſands, to which it belongs ; thus, 3+5+1+4+8+7+5=33, or, according to its local value, 33,000 ; of which total, the 3 to the right hand is taken down in the place of thouſands, and the other 3 carried to the column of tens of thouſands ; thus, 3+8+2+3+1+3+7=27, or, in its local value, 270,000 ; of which ſum the 7 is taken down in its homogeneous column, and the 2 in the place of hundreds of thouſands, to which it naturally belongs. The whole taken together becomes 273,582.

OBSERVATIONS.

1. Had the units place of any of the ſums of the columns been 0, it is plain that 0 would have been taken down in that place.

2. Had any of the ſums conſiſted but of one place only, there would have been nothing to carry to the next column.

3. The reaſon of this manner of operation is ſufficiently demonſtrated in the illuſtration, being a plain deduction from the nature of numbers ; and, as all the parts of any thing whatever muſt be equal to the whole, the ſum or total, thus found with ſufficient accuracy, muſt be equal to the ſeveral given numbers taken together.

4. Operations in this rule may be proved by dividing the numbers into two or three different claſſes, finding the ſums of theſe ſeverally, and collecting their totals again into one ; which, if the operations were right, will agree with that total which was taken at once. Men of buſineſs prove their ſummations by adding firſt upwards and then downwards.

EXAMPLES.

EXAMPLES.

7458		54856
5978		34785
4567		67857
18003		34158
8452		51213
3456		
3978	15886	242869 upwards.
33889=	33889	242869 downwards.

5. Expedition, as well as exactneſs in calculating, depends much upon improving the memory; and, as addition occurs more frequently in buſineſs than almoſt any other rule in arithmetic, both diſpatch and accuracy are abſolutely neceſſary: Wherefore, when one is ſufficiently accuſtomed to add the figures one by one, he ſhould be gradually led, to take them two by two, three by three, by either or more, as appears convenient; which will not only promote diſpatch, but be leſs liable to errour. Thus, for inſtance, the firſt four figures in the units place, of the firſt example, to one who hath been ever ſo little accuſtomed to addition, will at once preſent the ſum of 18, and the other two figures 14=32, *&c.*

CHAP. III. SUBTRACTION of INTEGERS.

SUBTRACTION finds the difference, called the *remainder*, betwixt a leſſer number, called the *ſubtrahend*, and a greater, called the *minuend*, and is the converſe of addition.

RULE.

Place the numbers, each of the ſame local value under one another reſpectively, the ſubtrahend in a line directly under the minuend. Then, beginning at the units place, if the figure in the ſubtrahend be equal to that correſponding in the minuend, write down a cipher for the difference; if leſs, take down the figure which repreſents the difference; but, if greater, increaſe it by 10, and then take down the difference; remembering at the ſame time, that however

ever oft the minuend muſt be ſo increaſed, the next place in the ſubtrahend muſt be likewiſe increaſed by unity. Proceed thus till the whole remainder is taken down and completed.

EXAMPLES in INTEGERS.

	(1.)	(2.)	(3.)	(4.)
Minuend,	8467548	546317	47856478	5741563
Subtrahend,	3254138	257168	39764789	3194585
Remainder,	5213410	289149		

Illuſtration of the ſecond example.

Beginning with the units place, becauſe 8 is more than 7, increaſe 7 with 10, and 17 becomes the minuend; therefore, 17−8=9, or 10+7−8=9; becauſe the minuend was thus increaſed by 10, the next figure in the ſubtrahend muſt be increaſed by 1, which in effect is 10. and then it will be 6+1=7; but ſtill the correſponding figure in the minuend is leſs, and therefore the ſame increaſe muſt be repeated, and then it will be 10+1−7=4. In the ſame manner, and for the ſame reaſon, the next figure in the ſubtrahend muſt be increaſed by 1, and it will become 2; the correſpondent figure to which in the minuend is 3, and their difference, without any increaſe, is 1; which is noted down, and nothing carred to the next figure in the ſubtrahend, *&c.*

OBSERVATIONS.

1. When all the figures in the minuend are greater than, or ſome of them equal to their correſpondents in the ſubtrahend, it will be obvious, that the difference of the figures put down as correſpondents, muſt, when taken as one ſum, be the difference or remainder required; for as all the parts of any number taken together are equal to the whole, ſo the difference of all the parts of any two numbers make together the difference of the wholes.

3. When any figure in the ſubtrahend is greater than its correſpondent one in the minuend, the latter, before ſubtraction, is encreaſed by 10; and, for that reaſon, the next ſubtrahend figure is encreaſed by 1: becauſe, from the nature of numbers, 10 in any place is equal to 1, in the next place to the left; therefore an equal number increaſes both factors

and the difference muſt accordingly be equal; for the ſame difference will alway, exiſt betwixt 9 and 17, as betwixt 19 and 27, or betwixt 29 and 37, *ad infinitum.*

3. If one number is to be ſubtracted from ſeveral, ſeveral from one, or ſeveral from ſeveral, it is plain, that they muſt be reduced to two factors before ſubtraction, by addition.

4. The accuracy of operations in this rule may always be proved by adding the remainder to the ſubtrahend whoſe ſum, when the operation is right, will be equal to the minuend; becauſe the ſubtrahend and remainder are the parts of the minuend, which is conſidered as the whole.

CHAP. IV. MULTIPLICATION of INTEGERS.

MULTIPLICATION ſerveth inſtead of many additions; and, from two numbers given, called the *multiplier* and *multiplicand*, findeth a third, called the *product*, which ſhall repeat the multiplicand ſo oft as the multiplier contains unity. For the more expeditious management of this rule, it will be neceſſary to commit to memory the following

TABLE OF MULTIPLICATION.

2× 2= 4	3× 3= 9	4× 5=20	5× 8=40	6×12=72	8×12= 96
2× 3= 6	3× 4=12	4× 6=24	5× 9=45	7× 7=49	9× 9= 81
2× 4= 8	3× 5=15	4× 7=28	5×10=50	7× 8=56	9×10= 90
2× 5=10	3× 6=18	4× 8=32	5×11=55	7× 9=63	9×11= 99
2× 6=12	3× 7=21	4× 9=36	5×12=60	7×10=70	9×12=108
2× 7=14	3× 8=24	4×10=40	6× 6=36	7×11=77	10×10=100
2× 8=16	3× 9=27	4×11=44	6× 7=42	7×12=84	10×11=110
2× 9=18	3×10=30	4×12=48	6× 8=48	8× 8=64	10×12=120
2×10=20	3×11=33	5× 5=25	6× 9=54	8× 9=72	11×11=121
2×11=22	3×12=36	5× 6=30	6×10=60	8×10=80	11×12=123
2×12=24	4× 4=16	5× 7=35	6×11=66	8×11=88	12×12=144

RULE.

When the multiplier conſiſts of any number within the bounds of the table, the product is found at once, by multiplying every figure, or place of the multiplicand into the multiplier, one after another, beginning with the units place; and the ſeveral products

are wrote down as the ſeveral ſums in addition; but, when the multiplier exceeds the bounds of the table, the product of every particular digit muſt be taken by itſelf, the firſt figure of every particular product placed directly below it's reſpective multiplier, to anſwer the local value thereof, and the ſum of theſe ſeveral products will be the product required.

EXAMPLES.

(1.)		(2.)	(3.)
875467543	Multiplicand.	437546754	47845678978
8	Multiplier.	12	11
7003740344	Product.	5250561048	

Illuſtration of the firſt example.

Beginning with the units place, by the table, $8\times3=24$, of which product 4 is taken down in its own place: then $8\times4=32+2$, in the ſecond place of the laſt product, $=34$, in its local value $=340$, whereof 4 falls to be noted down in its own place, *viz* the place of tens: again $8\times5=40+3=43$; 3 is taken down in its own place, and 4 is reſerved to be carried to the product of the ſucceeding figure; then $8\times7+4=60$; here 0 is noted: $8\times6+6=54$, 4 is noted: $8\times4+5=37$, note 7; $8\times5+3=43$, note 3: $8\times7+4=60$, note 0; $8\times8+6=70$, which is taken down all together, becauſe there is no new product to which the figure in the higheſt place could be carried.

Example (4.)		(5.)	(6.)	
745678		549356	607540573	
345		678	30405	
3728390			337702865	
2982712	3 × 1		270162292	3 × 1
2237034			202621719	
257258910	3		205357122065	3

OBSERVATIONS.

1. When the multiplier conſiſts of any number within the bounds of the table, the reaſon of the operation will be plain

plain from what hath been ſaid in addition, ſince multiplication is only a repetition of that rule, ſo oft as the multiplier contains unity; to be ſatisfied of which any one may make the experiment at pleaſure, by finding the ſum of any multiplicand repeated as oft as the multiplier contains unity.

2. When the multiplier exceeds the bounds of the table, the products are taken partially, and the ſum of theſe products muſt as certainly be the whole product, as it is true that the whole is equal to all its parts taken together. The reaſon of placing the firſt figure of every particular multiplier's product below its reſpective multiplying figure, will appear from this conſideration, that as each figure hath a ſimple and local value, both theſe values muſt be retained in the product: for inſtance, in the multiplier of the 4th example, 4 from the place in which it ſtands, is really 40, and conſequently the firſt figure of its product is not 2, but 20; for which reaſon it muſt ſtand in the place of tens. For the ſame reaſon, 4 in the multiplier of the 6th example is 400; and therefore 2, the firſt figure of its product, is 200, and for that reaſon ſtands in the place of hundreds.

3. Operations in this rule may be proved by ſhifting the factors, the reaſon of which is obvious: but more expeditiouſly by caſting out the 9s. For an example, take an illuſtration of the proof of example 4.

*7+4=11, exceeding 9 by 2, and 2+5+6=13, exceſs 4+7=11, exceſs 2+8=10, exceſs 1, which is noted on the right ſide of the croſs. The ſame is done by the multiplier thus, 3+4+5=12, exceſs 3, noted on the left ſide of the croſs then 3×1=3. noted, as it does not exceed 9, on the top of the croſs. If it had been 9, 0 would have been noted; if more than 9 or 9s the exceſs. After the ſame manner are the 9s. caſt out of the ſum of the products, and the laſt exceſs is found to be 3, which is ſet at the bottom of the croſs, and proves the operation to be right, being equal to the figure at the top. For becauſe in whatever place any figure ſtands, taken in its ſimple value, according to the place in which it ſtands, it will be equal to what remains, after all the 9s contained in its value are taken away; it follows, that the ſum of all the figures of which any number conſiſts, conſidered ſimply as ſo many units, is equal to the remainder, after all the 9s are taken out of that number, which can be found in the real value of each figure of which it conſiſts. Hence, if this ſum be leſs than 9, it is equal to what remains when all the 9s poſſible are taken out of that number. But if this ſum

is equal to, or exceeds 9, the remainder, when the 9s are taken out, will be equal to what remains when the 9s are taken out of the given number; becauſe the number of 9s in any number muſt be equal to the number of 9s which is contained in the ſeveral products, and in the ſum of the exceſs of 9s in thoſe parts.

CONTRACTIONS IN MULTIPLICATION.

1. When there are ciphers on the right of either or both factors, they may be neglected in the operation, but annexed to the ſum of the products.

EXAMPLES.

(1.)

7415678000
123000

22247034
88988136

912128394000000

(2.)

53400
560

3204
2670

299040000

Hence, to multiply by 1 and any number of ciphers annexed to it, is only to annex thoſe ciphers to the multiplicand.

2. When unity is in the place of tens of the multiplier, the product may be found in one line, by adding the product of that place in the multiplication; and the ſame method may be extended by practice, to 2 or 3 in the place of tens.

EXAMPLES.

(1.)

874675432
15.

13120131480

(2.)

84670000
23

1947410000

3. It will be found convenient, in applicate queſtions, to work by the component parts of the multiplier, which, for any ſmall number, will be found in the table: but if the multiplier be ſuch a number, for which no component parts can

can be exactly found, the neareſt component parts muſt be taken, and the multiplicand being added ſo often to the laſt product, as the product of the component parts comes ſhort of the given multiplier, or ſo often ſubtracted from it, as the product of the parts exceeds the given multiplier, the ſum in the one caſe; and remainder in the other, will give the true product.

EXAMPLES.

(1.)

54537543 by 56
7
38176280 1
8
3054102408

(2.)

3741500 by 74
8
2993 0
9
269388000 Product of 72
7483000 Product of 2
276871000

74

The proof is taken by caſting the nines out of the given multiplier, and not the artificial ones.

4. If the given multiplier is a number exceeding the bounds of the table, multiply by as many tens as the multiplier conſiſts of places ſave one, the laſt product by the firſt figure on the left hand, the next in order by the ſucceeding place, &c. the ſum of the products of theſe places gives that required.

EXAMPLES.

(1.)

8X436843246 by 578
10
7X4368432460
10
43684324600
5
218421623000=the product of 500.
30579027220=the product of 70.
3494745968=the product of 8.
252495396188=the product of 578.

(2.)

74563000 by 6002
10
745630
10
7456300
10
74563000
6
447378000000
149726000
447527726000

5. If

5. If the multiplier be any number near 100, 1000, 10000, &c. increaſe the multiplicand by as many ciphers as there are figures in the multiplier, and ſubtract the multiplicand from itſelf thus increaſed as often as the multiplier wants units of that by which the multiplicand was increaſed.

EXAMPLES.

(1.) Multiply 8754687 by 999
999 is 1 ſhort of 1000
Therefore 8754687000
8754687

8745932313

(2.) 4378 into 9998
43780000
8756 = 2×4378

43771244 = 9998×4378

6. When the multiplier can be parted into periods which are multiples of one another, the operation may be contracted in the following manner.

EXAMPLES.

(1.)

5697487
96488

45579896 = 8×5697487
273479376 = 6×45579896, becauſe 60×8=480
546958752 = 2×273479376, becauſe 200×480=96000

549739125656 = 5697487×96488

Note, One number is ſaid to be the multiple of another, when it contains it a certain number of times without any remainder.

Or in a reverſed order, thus:

(2.) 5742135 into 52575
52575

28710675	= 50000×5742135	for	50000
143553375	= 500×28710675	for	2500
430660125	= 3×143553375	for	75
301892747625	= 5742135×		52575

7. If the multiplier be a repetend of the ſame figure, multiply by one of the repeating figures; and the figures of that product

duct added, as if they had been wrote down in as many products as the multiplier repeated the same figure, give the product required.

EXAMPLES.

(1.)	(2.)
5478:6789	54018
22222	3333
10957:3578	162●54
21744735651 58	180041994

8. When the repeating figure is a high digit, collect the product of as many ones as there are digits in the multiplier, from the multiplicand, according to the rule in the last contraction, which product being multiplied into the repetend, will give the true product.

Example. 784325634 into 7777777

871472839519374 Products collected for 1111111.
7

6100309876635618 Product of 7777777.

There is another contraction for finding the product of any series of repeating figures, more elegant than any of the preceding, but it will come in more properly in the next chapter.

CHAP. V. DIVISION of whole numbers.

DIVISION findeth how oft one number is contained in another, and is a compendious method of subtraction, in the same sense that multiplication is a compendious method of addition.

RULE.

Place the dividing number, called the Divisor, on the left of the dividend, or number to be divided, and on the right of the dividend place the quotient, as

in

in the examples following. The factors being thus placed, point off ſo many places from the right of the dividend, as are equal to, or not exceeding the product of the diviſor, into any one of the 9 digits, and this is called a *dividual*: in which, having conſidered how often the diviſor is contained, note the number of times in the quotient, then ſubtract the product of that quotient figure, after it is multiplied into the diviſor, from the dividual, and to the remainder affix the next place in the dividend for a new dividual, with which proceed as before; and if the diviſor is not once contained in any dividual, increaſe the quotient with a cipher, before any new place is taken down to the right of the dividual; if any thing remains after all the places are taken down from the dividend, it is called the *remainder*, which, with the diviſor, expreſſeth ſome parts of unity, the number whereof is aſcertained by the remainder, and the quality by the diviſor.

EXAMPLES.

	(1.)		(2.)
Diviſor.	Dividend.	Quotient.	
12)	475678	($39639\frac{10}{12}$	15) 7846735 ($523115\frac{10}{15}$
	36		75
	115		34
	108		30
	76		46
	72		45
	47		17
	36		15
	118		23
	108		15
	(10) Remainder.		85
			75
			(10)

Illuſtration of Example firſt.

The diviſor 12 is found in the firſt dividual 47, three times, which is noted in the quotient, and being multiplied into the diviſor, preſents a product of 36, which is brought down below its own dividual 47, and ſubtracted therefrom, by which means we diſcover a remainder of 11: To this remainder, the next figure in the dividend being affixed, we are preſented with a new dividual of 115, which contains the diviſor 9 times; conſequently 9 is noted in the quotient, and multiplied into the diviſor; the product 108, being ſubtracted from its dividual 115, leaves a remainder of 7, to be increaſed by the next figure in the dividend, *viz.* 6; with which, and the remaining part of the dividend, we proceed as before, and at laſt there remains 10; which being taken up with the diviſor, and noted after the integral part of the quotient, expreſſeth ten twelfth parts of one.

OBSERVATIONS.

1. Since, by the above method of diviſion, the dividend is taken into as many dividuals as poſſible, and the quotient taken out of the firſt dividual as near as poſſible, the defect made the foundation of the ſucceeding dividual; and this operation being repeated ſo oft as there were places in the dividend to bring down, or quotient-figures to note, it will be plain, if there hath been no errour in the operation, that all the parts of the dividend have been added, and the number of times the diviſor is contained in thoſe parts hath been ſeparately found: And ſince all the parts taken together are equal to the whole, it muſt follow, that however often the diviſor is contained in thoſe parts which conſtitute the dividend, ſo often muſt the diviſor be contained in the whole dividend.

2. The beſt proof of operations in this rule is made by multiplying the quotient into the diviſor, whoſe product added to the remainder, if any, muſt be exactly equal to the dividend.

A proof leſs certain, but much more expeditious, may be made by caſting out the nines, as in multiplication, conſidering the integral part of the quotient as a multiplicand, the diviſor as a multiplier, and the dividend—the remainder as a product. The proof by the nines, in either caſe, can only be applied to integers or decimals; ſo that, upon the whole, the beſt and moſt general proof of multiplication is diviſion, and, *vice verſa*, of diviſion, multiplication.

Example (3.)

375)5478989(14610$\frac{239}{375}$
375
1728
1500
2289
2250
398
375
239
73289
102270
43830
5478989

Proof by multiplication.

(4.)

25476)88350768(3468
76428
119227
101904
173236
152856
203808
203808
0

0
3 X 6
0

Proof by casting out the nines.

CONTRACTIONS IN DIVISION.

1. In dividing by unity, the quotient will be found juſt equal to the dividend; therefore in dividing by 1, and any number of ciphers, if as many places are cut off from the right of the dividend, as there are ciphers to the right of 1 in the diviſor, the number to the left of the ſeparating point in the dividend will be the integral part of the quotient, and that to the right will be the remainder, or fractional part.

EXAMPLES.

Quot.	Rem.	Quot.	Rem.	Quot.	Rem.
1000) 4578.	567	1000) 545.	78	10000) 597.	8451

2. For the ſame reaſon, when there are ciphers to the right of any diviſor, an equal number of ciphers or figures may be cut off from the right of the dividend, and the remaining figures to the left being divided by the ſignificant figures in the diviſor, will quote the integral part, and the figures on the right of the point, annexed to the laſt remainder, will give the fractional part.

EXAMPLES.

EXAMPLES.

```
        (1.)                                  (2.)
25|000)35784675|000(1431387   35|00)37645|67(1075 2067/3500
       25                                    35
       ---                                   ---
       107                                    264
       100                                    245
       ---                                    ---
        78                                     195
        75                                     175
        ---                                    ---
         34                                    (2067)
         25
         ---
          96
          75
          ---
          217
          200
          ---
           175
           175
           ---
             0
```

Note, As an equal number of ciphers was cut off from both factors, there was nothing to constitute a remainder, and therefore there is no fractional part.

3. When the divisor consists but of one or two figures, the operation may be performed by a mental multiplication and subtraction; in which case, no part of the work needs to be noted but the quotient, and it may stand as in any of the subjoined

EXAMPLES.

```
   (1.)          (2.)                    (3.)
5)47856743     .8007456                75645÷25=3025 20/25
---------     ---------=114392 16/70
  9571348 3/5     70
```

4. When the divisor is a composite number, divide by its component parts continually, and the last quotient gives the integral part of the answer. For the fractional part, multiply the last remainder by the last divisor but one, and to the product add the remainder belonging to that divisor; multiply this sum by the next preceding divisor, to which add its cor-

reſpondent remainder; and thus proceed, till you have multiplied by the firſt diviſor, and added in the firſt remainder.

Example. Divide 7456785 by 75

$75=3\times5\times5$) 7456785

5) 1491357 — The remainder is found by ſaying $2\times5+2\times5=\frac{60}{75}$

3)298271 : 2

99423 : 2

Or the remainders may be valued, as in the following

EXAMPLE.

Divide 37841 by 48

$48=8\times6$) 37841

8) $6306\frac{5}{6}$

788 Rem. $2\frac{5}{6}=2\frac{17}{48}$

For 2 when reduced to 6ths $=\frac{12}{6}$ and $\frac{12}{6}+\frac{5}{6}=\frac{17}{6}$, but $1\times17=17$.

$8\times6=48$.

The laſt method will be found to be moſt convenient for practice, but it will be beſt underſtood when we are come to reduction of vulgar fractions.

5. When both factors are commenſurable, it will ſhorten the diviſion conſiderably, to abridge both factors according to the following method.

57456 by 56

4)56) 57456

2)14) 14364

7) 7182

1026 Quotient.

11)88) 47415665

8) 4310515

$5388147\frac{1}{11}$

This and the preceding contraction are founded on the ſame principles, *viz.* That if equal quantities be divided by equal quantities, the quotients will be equal; and though they may at firſt view ſeem to be one and the ſame, they will be differently applied, as may be obſerved in the ſequel.

Supplement

Supplement to contractions in multiplication.

1. The ſhorteſt method of multiplication, when the multiplier is any even part of 100, 1000, &c. is by diviſion: for if the multiplicand is encreaſed by a number of ciphers equal to the places in the multiplier, and a part of that product taken for the proportion the multiplier bears to 1 and the ſame number of ciphers annexed to it, the quotient will be the true product.

Multiply 74185 into 125
125 is of 1000 $\frac{1}{8}$ wherefore
8) 74185000

9273125 Product

Multiply 4759345 into $333\frac{1}{3}$
3) 4759345000

$1586448333\frac{1}{3}$ Product.

2. To multiply by a whole number and a fraction, find the product of the integral part as before, and take parts of the multiplicand for the fraction.

Multiply 3475 by $5\frac{1}{2}$	54789 $4\frac{2}{3}$	6758 $3\frac{3}{4}$	Note $\frac{1}{2}$ of $3=\frac{3}{4}$ of 1.
17375	219156	4)20274	
$1737\frac{1}{2}$	$18293\frac{1}{3}$	$5068\frac{1}{2}$	
19112$\frac{1}{2}$	$18293\frac{1}{3}$	25342$\frac{1}{2}$	
	$255742\frac{2}{3}$		

3. The digit 9 hath a property peculiar to itſelf, that whatever other digit, with any number of ciphers annexed, is divided by it, the quotient will conſiſt wholly of ſuch digits, and ſo many 9ths of an unit over; hence the following method of multiplying by repetends,

EXAMPLES.

(1.) 575 by 666	(2.) 4745 by 777	(3.) 3987 by 5555
6000	7000	50000
9)3450000	9)33215000	9)189350000
383333	3690555	22150000
383 Subtract.	3690 Subtract.	2215
382950 Product.	3686865 Product.	22147785

This laſt contraction will be demonſtrated immediately after diviſion of decimals, where it will be better underſtood.

CHAP.

CHAP. VI.

ESSAY ON MONEY, WEIGHTS, and MEASURES.

IN the preceding chapters we have endeavoured, with as much perſpicuity and conciſeneſs as poſſible, to ſhow the properties and combinations of abſtract or pure numbers, as far as concerned the fundamental rules of arithmetic, in a method that leads gradually to eaſe, diſpatch, and certainty in calculation. But before we can ſhow the uſe of theſe rules in matters of buſineſs, it will be proper to give ſome account of the monies, weights, and meaſures, which the Britiſh merchant hath occaſion to be acquainted with; as a proper knowledge of theſe is not only intimately connected with, but a *ſine qua non* in the mercantile buſineſs.

I. OF MONEY.

IN the firſt ages of commerce, there was little occaſion for computation, as one commodity was bartered for another by the bulk; a cuſtom which, even at this day, prevails among the ſavage unpoliſhed nations of Chili on the South ſea, in the land of Jeſſo on the Pacific ocean, and other barbarous countries: but by degrees, as improvements were made in the world, ſomething new was added daily to the conveniencies of life; and as ſuch a method of bartering commodities was found to be difficult and inconvenient, it was agreed among mankind to make choice of one commodity, which being in general and conſtant eſteem, an equivalent quantity of it might always remove the difficulty of bartering in kind. To determine therefore this ſubſtance that ſhould be in univerſal and conſtant eſteem, they made choice of gold and ſilver, not only becauſe they were diviſible and portable, but becauſe they were more valuable than other metals. Since there was a conſiderable difference in the nature of theſe two metals, and gold was more precious than ſilver, both on account of its rarity and intrinſic worth; beſides, the expenſe in working gold far exceeds the charge which attends the working ſilver, as appears by the tax paid upon each to the ſovereign lords of mints, that upon gold being only 5 of the hundred, and that on ſilver 20: it was therefore juſt to aſcribe a greater value to gold. And becauſe the baſer metal ought to be given in greater meaſure, that what was wanting in quality might be made up in quantity; it was likewiſe

was likewiſe found neceſſary to fix a proportion between them by ſome certain and determinate rule; whence it is, that, in the practice of commerce, though formerly the proportion of gold to ſilver was ſettled as ten to one, yet the matter is ſo ſettled at preſent, throughout the greateſt part of Europe, that 1 ounce of gold is worth about 15 ounces of ſilver. When this ſubſtance was agreed upon at firſt to be a common equivalent for any of the conveniences of life, the particular quantity of it to be given as the value of any thing elſe, was determined by the bulk and weight only: but afterwards, to ſave the trouble of proving this weight upon every occaſion, it was coined into certain forms by public authority, and impreſſed with a mark of diſtinction, expreſſing the quantity each piece contained, ſo that it ſhould always have the ſame determined value, and be every where the ſame both for matter and weight.

In Britain, as in all other trading places, the current money or ſpecie is either gold, ſilver, or copper. The ſtandard of gold coin is 22 carats of fine gold, mixed with 2 carats of alloy, in the pound weight Troy; and the ſtandard of ſilver coin is 11 ounces and 2 pennyweights of fine ſilver, mixed with 18 pennyweights of copper. Theſe maſſes being thus proportioned, and reſpectively divided into pieces of a certain weight, upon which the current ſtamp, authoriſed by the prince, is impreſſed, conſtitute the ſeveral coins we meet with in Britain; the value whereof is determined by an imaginary piece, called the *pound Sterling*, by which we buy and ſell, and keep all accounts.

The diviſion of the pound Sterling is as follows.

Farthings, marked -	qrs.
4 = 1 penny, - -	d.
48 = 12 = 1 ſhilling,	s.
960 = 240 = 20 = 1 pound, -	L.

When ſhillings and pence are wrote together, they are often in figures diſtinguiſhed thus, 4|5, *i. e.* 4 s and 5 d 10|, *i. e.* 10 s and |10, *i. e.* 10 d.

The coins uſed in Britain, with their value.

	L.	s.	d.
GOLD COINS.			
The Guinea, =	1	1	0
Half-guinea, =	0	10	6
Quarter guinea =	0	5	3
SILVER COINS.			
The Crown, =	0	5	0
Half-Crown, =	0	2	6
Shilling, =	0	1	0
Sixpence, =	0	0	6
COPRER COINS.			
The Halfpenny, =	0	0	½
Farthing, =	0	0	¼

There

There are ſome gold pieces bearing the ſtamp of other countries which are likewiſe current in Britain, namely, the Moidore, =L 1, 7 s and the Joannes, =L 3, 12 s and the half and quarter ditto.

The pound of gold Troy, including the alloy, is divided into 44 $\frac{1}{2}$ parts, which are ſtamped into guineas, and into 89 parts, when ſtamped into half-guineas.

OBSERVATION.

If an exact proportion between gold and ſilver is not maintained, and fixed unalterably, according to ſome univerſal rule adopted by the generality of the European nations, the conſequence may be dangerous to a kingdom in the affair of money.

Suppoſe that in ſome particular kingdom a money-ſyſtem prevails, that ſhall raiſe the gold above its real value, and that in this regulation, inſtead of the common proportion of 1 to 15, that now obtains, an ounce of gold is allowed to be equivalent to 16 ounces of ſilver, ſince ſuch an alteration would raiſe the gold $6\frac{2}{3}$ *per cent.* above its value, and reduce the ſilver to juſt ſo much below its worth; it is evident that this increaſe of the current price of gold would naturally cauſe the ſilver to be exported out of the kingdom; and as gold would be imported in its ſtead, and increaſe greatly, the nation muſt unavoidably loſe $6\frac{2}{3}$ *per cent.* of all the ſilver that would be thus exported.

On the other hand, ſhould the ſilver money be raiſed above its value, ſo that 14 ounces ſhould be deemed equivalent to one ounce of gold, while the proportion ſhould ſtand thus, the ſilver money would not only continue in the kingdom, but alſo increaſe greatly, and the gold coin would be exported in the ſame proportion; by which means the nation would ſuſtain a loſs of $7\frac{1}{7}$ *per cent.* Moreover, from theſe variations two abſurdities would follow: the one is, that both the prince and the people would loſe of that part of their monied property $6\frac{2}{3}$ *per cent.* ſhould the above diſproportion fall upon the gold coin; and $7\frac{1}{7}$ ſhould it fall upon the ſilver, The other inconvenience would be, that there would be no ſpecie to circulate in the kingdom, but either gold only, or ſilver only, according as the one or the other of theſe metals ſhould happen to be eſtimated above its true proportion. To maintain an exact proportion therefore between gold and ſilver, are eſſential points of good conduct, with regard to the preſervation

ſervation of money, that are by no means to be neglected. There is another conſideration, however, that hath a ſurpriſing effect on the money matters of a kingdom, and that is the balance of trade; which when it is againſt a nation, its money muſt be carried to foreign nations, to pay for the exceſs of goods imported above thoſe which have been exported; but if it is in its favour, the money will not only continue in it, but alſo increaſe and multiply.

The Laws of ENGLAND relating to MONEY.

By 20th *Edw.* I. merchants are prohibited from trafficking with money, and importing clipped coin, under the pain of forfeiture.

9th *Edw*, III. *c.* 1. Gold or ſilver plate, or coin, not to be exported without licence, under the pain of forfeiture. Search to be made for falſe coin imported.

Money not to be impaired in weight or alloy, 25th *Ed.* III. *c.* 13.

No coin to be current but the King's own, and any perſon may refuſe foreign coin, 27th *Edw.* III. *c.* 14.

Foreign coin not to be current in England, but to be melted down, 17th *Rich.* II. *c.* 1.

Coin or plate found in the cuſtody of perſons ready to paſs the ſeas, or in any ſhip, to be forfeited to the King, 2d *Hen.* IV. *c.* 5.

Treaſon to clip or file money, 3d *Hen.* V. *c.* 6.

Gold to be received in payment by the King's weight, 9th *Hen.* V. *c.* 11.

The mint-maſter to keep to his alloy, and to receive ſilver at the true value, on pain of double damages, 2d *Hen.* VI. *c.* 12.

Coins of gold and ſilver to continue current, notwithſtanding they may be cracked or worn, but not if they are clipped; monies clipped to be exchanged at the mint. Coin tranſported to Ireland above 6 s 8 d or Iriſh coin imported above 3 s 4 d to be forfeited. A circle to be made round the outſide of money, 14th and 15th *Hen.* VIII. *c.* 12.

Counterfeiting, impairing, &c. of coin, or foreign coin made current, is made high treaſon by 14th *Eliz. c.* 3. and 4. and by 18th *Eliz. c.* 1 and 7.

Silver coin melted down to be forfeited, and double value, 13th and 14th *Ch.* II. *c.* 31.

Gold and ſilver delivered into the mint to be aſſayed, coined, and delivered out, according to the order and time of bringing in, 18th *Ch.* II. *c.* 5.

Buying or ſelling clippings or filings, L. 500 penalty. Perſons melting coin to be impriſoned ſix months, beſides forfeiture, *&c.* Perſons apprehending money coiners, *&c.* to have L. 40 reward; and guilty perſons diſcovering two others, to be pardoned, 6th and 7th *Will.* III. *c.* 17.

Perſons bringing plate to the mint to be coined, not to pay for coinage, but to have the ſame weight of money delivered out. Perſons keeping public houſes to have no manufactored plate but ſpoons. Molten ſilver or bullion not to be ſhipped off, without a certificate from the lord mayor that oath hath been made that it is foreign bullion, under the penalty of L. 200; and officers may ſeize the bullion as forfeited. Gold or ſilver not exceeding L. 200,000, may be exported with a licence. Guineas not to go for more than 22 *s.* 7th and 8th *Will.* III. *c.* 19.

Hammered ſilver coin brought to the mint, to be received at 5 *s.* 4 *d. per* ounce; receivers of taxes, *&c* to receive money at 5 *s.* 8 *d. per* ounce, to be delivered back to the bringers in; and receivers, *&c.* to be paid into the exchequer, with an allowance of the deficiency in recoining. Silver-plate, *&c.* to contain 11 ounces and 10 pennyweights of fine ſilver in every pound, and to be marked with the two initial letters of the worker's name, on pain of forfeiture. Plate received at 5 *s.* 4 *d. per* ounce to be melted down, 8th and 9th *Will.* III. *c.* 7. and 8.

It is made high treaſon, to make any ſtamp, die, mold, *&c.* for coining, excepting by perſons employed in the mint, *&c.* Conveying ſuch out of the mint, the ſame. Colouring metal reſembling coin like gold or ſilver, or marking it on the edges, is likewiſe high treaſon: and mixing blanched copper with ſilver, to make it heavier, and look like gold, or receiving or paying counterfeit milled money, is felony, 8th and 9th *Will.* III. *c.* 26.

Hammered ſilver coin may be refuſed in payment, as not being the lawful coin of this kingdom, 9th, *Will.* III. *c.* 2.

Any perſon may cut, break, or deface pieces of ſilver money, ſuſpected to be counterfeit, or diminiſhed otherwiſe than by wearing; but if they ſhould, upon trial, appear to be lawful money, *&c.* to ſtand to the loſs, 9th and 10th *Will.* III. *c.* 21.

No perſon to make or coin any farthings or halfpence, or pieces to go for ſuch, of copper, under the penalty of L. 5 for every pound weight, 9th and 10th *Will. c.* 33.

On

On a ſcarcity of ſilver coin, for remedy guineas were ſunk to 21 *s.* by proclamation 3d *Geo.* I.

Perſons counterfeiting broad pieces of gold, or uttering them knowingly, to be guilty of treaſon, 6th *Geo.* II. *c.* 26.

Waſhing, gilding, or altering the impreſſion of any real or counterfeit ſhilling, or ſixpence, or braſs-money, to make the one paſs for a guinea, or half-guinea, or the other for a ſhilling or ſixpence, is high-treaſon. Knowingly uttering falſe money, for the firſt offence ſix months impriſonment, for the ſecond two years impriſonment, and for the third felony without benefit of clergy If any perſon, knowingly uttering falſe money, ſhall have about him any other falſe money, he ſhall ſuffer one year's impriſonment; and coiners of halfpence or farthings, two years impriſonment, *&c.* 15th *Geo.* II. *c.* 28.

Quarter-guineas were ordered to be coined in the 1ſt *Geo.* III. of which ſome had been ſtruck in the reign of *Geo* I. but were become ſo rare, that they were ſcarcely to be met with.

II. OF WEIGHTS.

As the ſecurity of commerce depends much on the juſtneſs of weights, moſt nations have taken care to prevent their being falſified. The ſtandard of weights in Britain is kept in the exchequer, by a particular officer, called the *clerk* or *comptroller of the market*. By the 27th chapter of *Magna Charta*, the weights are to be the ſame all over England; but as commerce flouriſhed, and introduced a greater variety of commodities, it was found convenient to vary the original weight, and likewiſe invent others better calculated for diſpatch in buſineſs, which hath introduced a diverſity of weights, in almoſt every different county or province. The firſt of all the weights uſed in Britain was a grain of wheat, picked out of the middle of the ear, which, being well dried, became the leaſt denomination of Troy weight, now uſed for gold, ſilver, jewels, ſeeds, liquors, bread, and medicines.

TABLE OF TROY WEIGHT.

Grains.				
24	=	1	pennyweight,	dwt.
480	=	20	1 ounce,	
5760	=	240 = 12 =	1 pound,	lb.

APOTHECARIES WEIGHT.

Is deduced from Troy; but convenience taught them to vary the diviſion, for compounding their medicines, according to the following

TABLE.

Grains.

20 = 1 ſcruple,
60 = 3 = 1 dram,
480 = 24 = 8 = 1 ounce,
5760 = 288 = 96 = 12 = 1 pound, lb.

AVOIRDUPOISE WEIGHT.

Was rather introduced by chance, and confirmed by cuſtom. than fixed by any law. The Troy weight was in practice found to be too ſmall for coarſe and heavy goods, ſuch as grocery wares, pitch, tar, roſin, wax, tallow, flax, hemp, *&c.* copper, tin, iron, lead, ſteel, fiſh, fleſh, butter, cheeſe, ſalt, *&c.*; for which, and other ſuch goods, it was thought proper to allow a greater weight than the law had provided, which in this weight exceeds the Troy by $\frac{1}{6}$, one pound Avoirdupoiſe being equal to 1 lb. 2 oz. 11 dwt. 15$\frac{1}{2}$ grains Troy. In lead, they give only 19$\frac{1}{2}$ cwt. to the ton or fodder.

TABLE of AVOIRDUPOISE GREATER WEIGHT.

lb.
28 = 1 quarter, qr.
112 = 4 = 1 hundred weight, cwt.
2240 = 80 = 20 = 1 tun.

Ditto LESSER WEIGHT.

Drops.
16 = 1 ounce.
256 = 16 = 1 pound.
3584 = 224 = 14 = 1 ſtone.

After the union, when the weights in Scotland were attempted to be reduced to Engliſh ſtandard, it was found that the Scotch Troy pound was equal to 7000 grains; and the Engliſh Avoirdupoiſe to 7000: hence, the Scotch Paris, or Amſterdam pound will be to the pound Avoirdupoiſe as 38 to 35. Beſides the Scotch Troy weight, commonly known by the name of *Dutch weight*, whereof a table is ſubjoined, there is another weight derived from it, called *Tron weight*, which, in different places, conſiſts of a heavier or lighter pound,

pound, according as cuſtom hath eſtabliſhed it. The pound Tron weight runs from 20 to 24 ounces generally, and in ſome places, but rarely, falls as low as 19 ounces.

TABLE of Scotch Troy, or Dutch Weight.

Grains.
36= 1 drop.
576= 16= 1 oz.
9216= 256= 16= 1 lb.
147456=4096=256=16=1 ſtone.

Note, The Tron weight is divided in the ſame manner as the Troy in the adjacent table, excepting the pound into ounces, of which there is no certain regulation.

Wool weight is founded on, and derived from Avoirdupoiſe, the pound in both being the ſame, but the greater weights different.

TABLE of WOOL WEIGHT.

Pounds.

7= 1 clove.
14= 2= 1 ſtone.
28= 4= 2= 1 todd.
182= 26= 13= 6½= 1 wey.
364= 52= 26= 13 = 2= 1 ſack.
4368=624=312=156=24=12= 1 laſt.

Note 1. Some few authors make 8 pounds in the clove.

2. Woolſtaplers generally purchaſe their wool by the todd, but ſell it again, when ſorted and ſtapled, by the pack, conſiſting of 240 pounds.

The REFINERS WEIGHTS.

Blanks.
24= 1 perrot.
480= 20= 1 mite.
9600=400=20=1 grain.

Note, What they denominate *carats* are the $\frac{1}{24}$ of a lb, an oz, or any other weight.

The Weights for Merchandizes uſed in Holland.

24 grains = 1 drachm: 3 drachms, or 72 grains, = 1 groſs; 30 grains = 1 engel; 10 engels, or 4 groſs and 2 grains, = 1 loot;

1 loot; 16 loots, or 8 ounces, = 1 mark; 2 marks = 1 pound; 8 pounds = 1 ſtone; 165 pounds = 1 waggon, or wage; 400 pounds = 1 load; 15 pounds = 1 liſpond; 20 liſponds = 1 ſchippond.

DUTCH WEIGHTS for GOLD and SILVER.

32 aces = 1 engel, 20 engels = 1 ounce, 8 ounces = 1 mark, for groſs gold.

24 parts = 1 grain, 12 grains = 1 carat, 24 carats = 1 mark, for fine gold.

Note, The mark weights are about 1 *per cent.* lighter than the Troy weight of London.

WEIGHTS for MERCHANDISE uſed in HAMBURG.

2 loots = 1 ounce, 16 ounces = 1 pound, 10 pounds = 1 ſtone of wool or feathers, 14 pounds = 1 diſpound, 20 pounds = 1 ſtone of flax, 8 diſpound = 1 center = 120 pounds Avoirdupoiſe of London. 16 pounds of feathers or wool is a diſpound, and 20 diſpounds = 1 ſchippound of the ſame. 16 diſpounds = 1 tun of butter or tallow.

100 pounds of Hamburg = 98 of Amſterdam = $103\frac{1}{2}$ of Antwerp = $107\frac{1}{4}$ of London. See the table in the compariſon of weights and meaſures.

III. MEASURES.

The ſame neceſſity that introduced money and weights may juſtly be ſuppoſed to have introduced meaſures; as the moſt certain method of aſcertaining quantities bought and ſold. The common meaſures uſed in Britain are thoſe which follow.

I. CLOTH MEASURE, which is of four kinds.

1. The yard = 4 quarters = 16 nails = 36 inches; by which are meaſured and ſold all kinds of Engliſh woolen cloths, linen, wrought ſilks, tape, &c.

2. The Engliſh ell = $1\frac{1}{4}$ yard = 20 nails = 45 inches, by which is meaſured chiefly a ſpecies of fine linen called *Holland.*

3. The Flemiſh ell = $\frac{3}{4}$ yard = 12 nails = 27 inches, chiefly applied to tapeſtry.

4. The

4. The Scotch ell=1$\frac{1}{16}$ yard= 37 inches, by which green linen, and moſt of the private or houſe manufactures in the country, are bought and ſold.

II. CORN MEASURES, which are of two kinds.

1. Engliſh, in which the pint is found to weigh 1 pound Troy, and the ſeveral denominations are as follow.

TABLE of ENGLISH DRY MEASURE.

Pints.							
8=	1 gallon.						
16=	2=	1 peck.					
64=	8=	4=	1 buſhel.				
256=	32=	16=	4=	1 comb.			
512=	64=	32=	8=	2=	1 quarter.		
2560=	320=	160=	40=	10=	5=	1 wey.	
5120=	640=	320=	80=	20=	10=	2=	1 laſt.

Corn, ſalt, coals, lead-ore, and other dry goods, are meaſured according to this table. Corn is generally ſold in England by the quarter, 5 whereof are reckoned to the ton of freight. The ton of wheat weighs between 2200 and 2500 pounds Avoirdupoiſe; of rye, between 2100 and 2240 pounds ditto; and of barley, between 1700 and 1800

By the ſtandard in his Majeſty's exchequer, every round buſhel with a plain and even bottom, 18$\frac{1}{2}$ inches wide throughout, and 8 inches deep, is eſteemed a legal corn buſhel, and will contain 2150$\frac{42}{100}$ cubic inches; conſequently the corn-gallon contains 268$\frac{4}{7}$ cubic inches.

2. Scotch, in which the boll of meal weighs 8, and amongſt the farmers in the north, frequently 9 ſtone Dutch, or Scotch Troy weight; is divided as follows.

Lippies.				
4=	1 peck.			
16=	4=	1 firlot.		
64=	16=	4=	1 boll.	
1024=	256=	64=	16=	1 chalder.

Note, The wheat firlot in Scotland contains 21$\frac{1}{4}$ pints Scotch meaſure, and the bear or barley firlot 31; hence the Scotch wheat firlot is to the Engliſh corn buſhel as 100 to 99$\frac{21}{100}$

3. Liquid

3. Liquid meaſure was originally raiſed from Troy weight, as is evident from ſeveral ſtatutes, enacting, that 8 pounds Troy of wheat, properly prepared, ſhould weigh one gallon of wine-meaſure, the diviſions and multiples whereof ſhould form the other meaſures, and be the common ſtandard throughout the whole kingdom; yet the invention of a new weight introduced likewiſe a new gallon adjuſted thereto, exceeding the former in the proportion of Avoirdupoiſe weight to Troy, which ſerves to proportion the ſeveral denominations of ale and beer meaſure. The ſealed gallon at Guildhall, which is the ſtandard for wines, ſpirits, mead, perry, cyder, vinegar, honey, oil, *&c* is ſuppoſed to contain 231 cubic inches, on which ſuppoſition, the other meaſures raiſed therefrom will contain proportionally; yet, by actual experiment, made in 1688, in preſence of the Lord Mayor and commiſſioners of exciſe, this gallon was only found to contain 224 cubic inches; notwithſtanding it was agreed to continue the computation, upon the ſuppoſition of 231 cubic inches to the gallon, as before.

TABLE of WINE MEASURE.

Solid inches.

231 = 1 gallon.
4158 = 18 = 1 runlet.
7276½ = 31½ = 1¾ = 1 barrel.
9702 = 42 = 2⅓ = 1½ = 1 terce,
14553 = 63 = 3½ = 2 = 1½ = 1 hogſhead, (*hhd.*)
19279 = 84 = 4⅔ = 2⅓ = 2 = 1¼ = 1 puncheon.
29106 = 126 = 7 = 4 = 3 = 2½ = 1½ = 1 butt.
58212 = 252 = 14 = 8 = 6 = 4½ = 3 = 2 = 1 tun.

Ale and beer meaſure, as was formerly obſerved, is deduced from the Avoirdupoiſe weight, and therefore the gallon muſt be much larger than the gallon in wine-meaſure. The ſtandard ale quart, kept in the exchequer, hath been found by experiment to contain juſt 70⅔ cubic inches; conſequently the ale-gallon muſt contain 282 cubic inches. Hence

ALE-MEASURE TABLE.

Cubic inches.

282= 1 gallon.
2256= 8=1 firkin.
4512=16=2=1 kilderkin.
9024=32=4=2=1 barrel.
13536=48=6=3=1½=1 hhd.

TABLE of BEER-MEASURE.

Solid inches.

282= 1 gallon.
2538= 9= 1 firkin.
5076= 18= 2=1 kilderkin.
10152= 36= 4=2=1 barrel.
15228= 54= 6=3=1½=1 hogſhead.
30456=108=12=6=3 =2=1 butt.

Note, This diſtinction, or difference betwixt ale and beer meaſure, is only uſed in London; for, in all other places, the following table of beer or ale, whether ſtrong or ſmall, is to be obſerved according to a ſtatute of exciſe, made in the year 1689.

Note, in meaſuring ſoap and herrings, 8 gallons is conſidered as a firkin.

Cubic inches.

35¼= 1 pint.
282 = 8= 1 gallon.
2397 = 68= 8½=1 firkin.
4794 =136=17 =2=1 kilderkin.
9588 =272=34 =4=2=1 barrel.
14382 =408=51 =6=3=1½ =1 hogſhead.

In Scotland, the exciſe and breweries uſe the Engliſh meaſure; but retailers and victuallers in the country uſe the Scotch pint, of 103⅗ ſolid inches, whoſe diviſions and multiples are as follow.

4 gills = 1 mutchkin, 2 mutchkins = 1 chopin, 2 chopins = 1 pint, 2 pints = 1 quart, and 4 quarts = 1 gallon.

4. Long meaſure, among other improvements, took its riſe from wheat, three grains of which, properly prepared, were, in length, made the meaſure of an inch, as in the

TABLE.

Grains.					
3 =	1 inch.				
36 =	12 =	1 foot.			
108 =	36 =	3 =	1 yard.		
594 =	198 =	$16\frac{1}{2}$ =	$5\frac{1}{2}$ =	1 pole.	
23760 =	7920 =	660 =	220 =	40 =	1 furlong.
190080 =	63360 =	5280 =	1760 =	320 =	8 = 1 mile.

Note, 4 poles, or 22 yards, is the length of Gunter's chain, conſiſting of 100 links, each link = $73\frac{3}{100}$ inches. But the chain for ſurveying in Scotland ſhould be 74 feet.

Note, 3 miles = 1 league, and 20 leagues = 1 degree, by common reckonings; but a degree of a great circle, meaſured upon the ſurface of the earth, has been found, by the beſt geographers, to be equal to $69\frac{1}{2}$ Engliſh miles = 25 French leagues.

5. Square meaſure was founded upon long meaſure, and is differently divided in England and in Scotland.

In Engliſh ſquare meaſure, 144 ſquare inches = 1 foot ſquare; 9 feet ſquare = 1 ſquare yard; $30\frac{1}{4}$ ſquare yards = 1 pole; 40 poles = 1 rood; and 4 roods = 1 acre.

Though the ſtatute pole be $16\frac{1}{2}$ feet, in meaſuring fens and woodlands, they uſe a pole of 18 feet, and for foreſts 21 feet. 40 poles in length and 4 in breadth, or 220 yards in length, and 22 in breath, make a ſtatute acre. The French acre, or arpens, is $26\frac{1}{3}$ yards in breadth, and $261\frac{1}{3}$ yards in length, and is to our ſtatute acre as 19 to 16.

Maſons meaſure their hewn work by the Engliſh foot, painters and plaſterers by the yard. Glaziers reckon only 8 inches to their lineal foot, and 64 to their ſquare foot.

The ſquare meaſure uſed in Scotland is thus divided.

36 ſquare ells = 1 fall, 40 falls = 1 rood, and 4 roods = 1 acre.

The Scotch acre by ſtatute is to the Engliſh as 100,000 to 78694.

In Scotland, ſlaters, maſons, and paviers uſe the ſquare ell and the fall in meaſuring their work, and the land-ſurveyors, the fall, the rood, and the acre.

There are ſome commodities ſold by the dozen, of which we reckon 12 = 1 dozen, 12 dozen = 1 ſmall groſs, and 12 ſmall groſs = 1 great groſs.

Paper

Paper is ſold by the following denominations, in which 24 ſheets = 1 quire, 20 quires = 1 ream, and 10 reams = 1 bale.

Parchment thus: 12 ſkins = 1 dozen, 15 dozen = 1 roll.

Yarn thus: 120 threads = 1 cut, 2 cuts = 1 heer, 6 heers = 1 hank, and 4 hanks = 1 ſpindle.

In glaſs, 5 pounds = 1 ſtone, and 24 ſtone = 1 ſeam.

The freight of bale goods is often determined by the tunnage, in which 40 ſolid feet are reckoned = 1 tun.

Having thus given a brief and ſuccinct account of the meaſures uſed in Great Britain, for the benefit of the dealer in foreign ſpirits, *&c.* I ſhall add Mr. Poſtlethwayt's account of the different meaſures and veſſels uſed in moſt parts of the world.

Of MEASURES for WINE and VINEGAR.

"The veſſels for containing wine and brandy have different names, according to the quantities they contain, and the countries where they are made uſe of.

The veſſel called in Germany *woeder*, made uſe of for keeping the wines that grow upon the Rhine and the Moſelle, do ordinarily contain 14 aams of Amſterdam, but ſometimes they contain more and ſometimes leſs.

The aam of Amſterdam is a meaſure of 4 anckers, reckoning the ancker of 2 ſteckans.

The ſteckan contains 16 mingles, each of which makes two pints.

The verge, or verteel, of the wines upon the Rhine and the Moſelle, *&c.* is reckoned but 6 mingles, that of brandy is counted $6\frac{1}{2}$ mingles, as we ſhall ſee hereafter.

The hogſhead of Bourdeaux, according to the juſt meaſure, ſhould contain $12\frac{1}{2}$ ſteckans, or 200 mingles of wine and lee; and 12 ſteckans, or 192 mingles clear wine; ſo that the tun of Bourdeaux, conſiſting of 4 hogſheads, contains 50 ſteckans, or 800 mingles, wine and lee, and 48 ſteckans, or 768 mingles clear wine.

The tun of Bayonne, and other places thereabout, is reckoned 240 ſteckans, meaſure of Amſterdam, there being likewiſe 4 hogſheads to a tun.

In England, and eſpecially at London, they reckon the hogſhead 63, and the tun 252 gallons. The ſaid gallon weighs $7\frac{1}{2}$ pounds weight of London; ſo that the 63 gallons, or the hogſhead, ſhould weigh $472\frac{1}{2}$ pounds, and the tun

1890 pounds weight of London. The ſaid gallon is ſaid to contain 4 Paris pints.

The hogſhead of Bourdeaux ſhould contain 110 pots with the lee, and 100 pots clear wine, meaſure of the ſaid place; ſo that the ſaid pot of Bourdeaux contains about 2 mingles of Amſterdam.

The Bourdeaux tun of wine ſhould weigh, with the hogshead, 2000 pounds weight; and, in marine terms in freighting of ſhips, by a tun is meant 2000 pounds weight; ſo that when it is ſaid any ſhip is of ſo many tuns, it is to be underſtood that the ſhip can carry ſo many times 2000 pounds weight: though in Holland, Flanders, and other northern countries, they only talk of laſts, containing 2 tuns each, or 4000 pounds weight.

The Rheniſh and Moſelle wines are ordinarily ſold at Amſterdam, the former at ſo many florins of about 20 each, current money, and the latter ſo many rixdollars, of 50 ſtivers each, current money, for the aam of 20 verges or verteels, the verge being, at that rate, 6 mingles, as already ſaid.

French, Spaniſh, and Portugal wines are ſold at ſo many pound groſs the tun of 4 hogſheads, and there is ordinarily 1 *per cent.* rebate for payment in ready money, both buyer and ſeller paying brockerage, each 6 ſtivers *per* tun.

The muid of Paris contains 150 quarts, or 300 pints with the lee, and 280 pints clear wine, meaſure of Paris.

There are all over France a great many veſſels for keeping of wine, different from one another, according to the cuſtom of the ſeveral provinces where they are made uſe of; of which, though there be ſcarce any poſſibility to give an exact account we ſhall here ſet down the regular fractions of the muid of Paris, 3 of which make the tun of France; and, as we have occaſion to ſpeak of the meaſures of the other provinces of France, we ſhall give as diſtinct an account as we can of their contents.

The pint of Paris is a meaſure pretty well known all over the world; 2 of thoſe pints make 1 quart, 4 quarts 1 ſextier, and 36 ſextiers 1 muid of Paris: 3 of which (as is already ſaid) make 1 tun of France.

The meaſure they make uſe of in Provence is called a *millerole*; that of Thouloufe ſhould weigh 130 pounds, and ought to contain 66 Paris Pints, which is about 100 pints of Amſterdam.

At

At Montpelier, and ſeveral other places of Languedoc, their muid contains 18 ſextiers, and the ſextier 32 pots; ſo that the muid, which makes but 35 ſteckans, or 560 mingles of Amſterdam, makes 756 pots of Montpelier; by which it appears that the pot of Montpelier is $\frac{1}{27}$ leſs than the mingle of Amſterdam. However, you muſt here take notice that the caſks of Montpelier are not all of an equal meaſure, ſome being bigger than others; and in ſeveral places of Provence, as well as High and Low Languedoc, they frequently tranſport wines, oils, and other ſuch goods, in veſſels made of goat-ſkins.

The butts and pipes of Seville, Malaga, Alicant, Liſbon, Port a Port, Canaries, and iſles of Fagel, &c. are likewiſe of different ſizes; for the tun of Malaga, conſiſting of 2 butts or pipes, (which they call *perſemyn* at Amſterdam), is reckoned only 36 or 37 ſteckans; and thoſe of other places are reckoned at 25 or 26 ſteckans the butt or pipe.

As for the wine at Hamburg and Lubeck, it is ſold at ſo many rixdollars, of 48 ſtivers, or 3 marks lubs *per* tun.

Of BRANDY.

French, Spaniſh, and Portugueſe brandy, is ordinarily put into big caſks, which ſome call *pipes*, others *butts*, others *pieces*, *viz.* according to the cuſtom of the places, there being no poſitive meaſure regulated for that liquor.

In France it is ordinarily put into great caſks, which they call at Bourdeaux *pieces*, at Rochelle, Nantes, Cognac, Montguion, the iſle of Rhé, &c. *pipes*, which (as we have already ſaid) contain ſome more than others, there being ſome which hold at Amſterdam from 60 to 90 verges, or verteels; and they reduce thoſe meaſures into hogſheads, by reckoning as under, for

1 hogſhead makes
- 27 verges of Cognac, Montguion, Rochelle, and the iſle of Rhé.
- 29 of Nantes, and other places in Britany and Anjou.
- 32 of Bourdeaux, and other places in Guienne.
- 32 of Bayonne, and places thereabouts.
- 30 of Amſterdam, and other places of Holland.
- 30 of Hamburg and Lubeck.
- 27 of Embden.

In Provence and Languedoc, they ſell it at ſo much the quintal, or 100 weight with the caſk.

At

At Bruges they call the verges *ſeſters*, of 16 ſtoups to a ſeſter, which they ſell at ſo much a ſtoup.

At London, and generally through all England, they count only by gallons, as we have ſaid already.

The mingle of brandy weighs at Amſterdam, 2 pounds 4 ounces; and the verge, or verteel, about 14 pounds; at which rate, the 30 verges muſt weigh about 420 pounds.

At Bourdeaux, though pieces of brandy contain from 50 to 90 verges, they reckon but 32 to the hogſhead; the verge is ſomething leſs than $3\frac{1}{2}$ pots.

You muſt know that whatever there is at Bourdeaux in a piece of brandy more than 50 verges, is called by the farmers of the King's duty *exces*, or an exceſs, and pays ſo much *per* verge, beſides the duties of ſortie, or exportation (as they call it) for the 50 verges.

Thoſe that make brandy ſeldom or never put it in ſmall barrels, or tierces, except it be deſigned for ſome particular places in America, or elſewhere, where thoſe ſmall meaſures are advantageouſly ſold to people, who, perhaps, would not be able to buy a pipe at a time; for a piece of brandy that contains perhaps $1\frac{1}{2}$ of an ordinary piece, coſts but very little more of freight and carriage than one that contains $\frac{1}{2}$ or $\frac{1}{3}$ leſs.

At Hamburg it is likewiſe ſold at ſo many pounds groſs, of $7\frac{1}{2}$ marks lubs *per* pound groſs, or at ſo many rixdollars in Banco; but at Lubeck it is paid in current money there being no bank.

At Bremen, Copenhagen, and Embden, it is alſo ſold at ſo many rixdollars; and in this laſt place the hogſhead is counted but 27 verges.

At London it is ſold by the tun of 252 gallons; and, in ſhort, in every country according to the cuſtom of the country, which muſt always be ſtrictly inquired into by the dealers for their government.

Of MEASURES for OIL of OLIVES.

The oil of olives is ordinarily kept in butts or pipes, containing from 20 to 25 ſteckans, at 16 mingles a ſteckan; and there go 717 mingles, or 1434 pints of Amſterdam, to the tun of oil. They reckon at Genoa that the barrel of oil of olives weighs $187\frac{1}{2}$ pounds nett, of their weights, which make 125 pounds of Amſterdam; and 14 barrels make 717 mingles of the ſaid place, or thereabout.

At

At Leghorn, the barrel of oil of olives weighs 85 pounds of their weight, which is a little more than 59 pounds of Amſterdam.

In Provence they ſell it by the meaſure of that country, called *millerole*, containing 66 Paris pints, which make about 100 pints of Amſterdam; and, in ſome places of that country and of Lower Languedoc, they put it in certain veſſels made of goat-ſkins, as they do the wine.

In Spain and Portugal it is put in butts and pipes, to be carried over ſeas, and ſometimes in great earthen veſſels called *jars*.

Of Measures for Fish Oil.

Coarſe fiſh oil is ordinarily kept in barrels, containing from 15 to 20 ſteckans each.

Of Measures for Honey.

Honey is kept in many different ſorts of veſſels of wood and earth, and ſold in ſome places by meaſure, and in other places by weight.

At Amſterdam they ſell it at ſo many pounds groſs *per* ton conſiſting of 6 tierces or aams, or by ſo many florins the barrel, or the 100 weight. The Bourdeaux and Bayonne honey is ſold at Amſterdam from 30 to 40 l. groſs the tun.

Of Round Measures for Grain, &c.

As the great diverſity of meaſures of capacity renders it very troubleſome for merchants to calculate the quantities thereof, it will be very neceſſary to give an account of thoſe that are uſed in the principal places of Europe for trade.

The laſt is of ſeveral ſorts, but all comprehended in theſe two, *viz.* the ſea laſt, and that uſed by land.

A laſt is reckoned at ſea both with regard to meaſure and weight, according to the nature of the goods.

In meaſure, there are allowed to a laſt of goods 2 tuns, or 8 hogſheads of wine, 5 pieces of brandy, or prunes, 12 barrels of herrings or peaſe, 13 barrels of pitch, 4 pipes or butts of oil of olives, and ſeven quarters or barrels of fiſh oil.

By weight, there is generally allowed to the laſt 4000 lb. but, as wool is bulky, they reckon only 2000 lb. to the laſt thereof,

thereof, and 3600 lb. of almonds and ſo likewiſe they make ſome abatements of ſeveral other ſorts of goods in proportion to their bulk.

The land-laſt is not the ſame in all places, there being ſome difference introduced by cuſtom in the ſeveral countries of Europe.

Of the MEASURES of CAPACITY of AMSTERDAM and HOLLAND, &c.

The laſt of Amſterdam contains 27 muds, and each mud 4 ſcheppels.

Or, otherwiſe, the laſt of Amſterdam contains 36 ſacks, and the ſack 3 ſcheppels.

So that the mud is $\frac{1}{9}$ of the ſcheppel, and the ſcheppel is only $\frac{3}{4}$ of the mud.

A laſt of wheat commonly weighs between 4200 and 4800 lb. rye between 4000 and 4200 lb. and barley between 3200 and 3400 lb.

But thoſe commodities are ſo much ſubject to alteration, by their humidity, &c. that there is but little certainty in their weight.

The laſt of Amſterdam makes 19 ſextiers of Paris, or 38 buſhels of Bourdeaux; and 3 laſts make 4 muds of Rouen.

The laſt of Munickendam, Edam, Purmeran, and ſeveral other places of North Holland, is reckoned equal to that of Amſterdam.

But that of Hoorn and Enchuyſen, being likewiſe towns in North Holland, is of 22 muds, or 44 ſacks, of 2 ſcheppels each; and ſo is that of Muyden, Naerden, and Weeſoop, ſmall towns in the neighbourhood of Amſterdam.

At Haerlem they reckon 38 ſacks to the laſt, their ſacks conſiſting of 3 ſcheppels, 4 of which make 1 hoedt of Rotterdam, and 14 of thoſe ſacks make 1 hoedt of Delft

The laſt of Alkmaer, in North Holland, contains 26 ſacks.

They reckon 44 ſacks to the laſt of Leyden, and 8 ſcheppels to the ſack.

The laſt of Rotterdam, Delft, and Schiedam, is compoſed of 29 ſacks, and the ſack of 3 ſcheppels, of which $10\frac{2}{3}$ make 1 hoedt; where it is to be obſerved, that the laſt of thoſe places is 2 *per cent.* more than that of Amſterdam.

At Tergow they reckon 28 ſacks to the laſt, 3 ſcheppels to the ſack. and 32 ſcheppels to the hoedt.

Of the LAST of UTRECHT.

At Utrecht they reckon 25 muds, or ſacks, to the laſt, 10½ of which ſacks make 1 hoedt of Rotterdam.

The laſt of Amersfort is compoſed of 64 ſcheppels.

That of Montfoort, Yſſelſteid, Vianen, *&c.* is greater than that of Rotterdam; it is compoſed of 18 muds, and the mud of 2 ſacks.

Of the LAST of FRIESLAND.

The laſt of Leeuwarden, Haerlingen, and other towns of Weſt Frieſland, is compoſed of 33 muds.

And that of Groningen in Eaſt Frieſland is of the ſame meaſure.

Of the LAST of GUELDERLAND, and county of CLEVES.

The laſt of Nimeguen, Arnham, and Dreſburg, is compoſed of 22 mouvers, and the mouver of 4 ſcheppels, 8 of which mouvers make 1 hoedt of Rotterdam.

At Thiel they reckon 33 ſcheppels to the laſt.

At Burenande 68 ſcheppels.

At Haerderwick they reckon 11 muds to 10 of Amſterdam

Of the LAST of OVER-YSSEL.

The laſt of Campen is of 25 muds for corn, 9 of which make 1 hoedt of Rotterdam.

And 9 muids of Zwoll make likewiſe 1 hoedt of Rotterdam.

The laſt of Deventer contains 36 muids of 4 ſcheppels each.

Of the LAST of ZELAND.

The laſt of Middleburg is compoſed of 4½ ſacks of 2 ſcheppels each, or a little more; and that of Fleſſing, Zirickzee, the Brill, and ſome other places, is ſomewhat different from it, the ſack being there reckoned 2½ ſcheppels.

Of the LAST of BRABANT.

The laſt of Antwerp is compoſed of 38 verteels, of which 37½ make 1 laſt of Amſterdam.

Their verteel is compoſed of 4 mukens, and 32 verteels made the ſack for oats.

At Bruſſels they reckon 25 ſacks equal to the laſt of Amſterdam.

At Malines they reckon 28 verteels equal to the laſt of Amſterdam.

The laſt of Louvain is compoſed of 37 muds, and each mud of 8 halſters.

At Breda and Steenbergue they reckon 33½ verteels to the corn laſt, and 29 for oats; and 13 verteels make 8 ſacks, or 1 hoedt of Rotterdam.

At Bergen-op-zoom, they allow 34 verteels to the laſt of corn, and 28½ for oats.

That of Bois-le-duc is compoſed of 20½ mouvers, 8 of which make 1 hoedt of Amſterdam.

Of the LAST of ſeveral towns in FLANDERS.

The laſt of Ghent is compoſed of 56 halſters for corn, and of 38 for oats. Their mud is compoſed of 6 ſacks, each ſack of 2 halſters.

At Bruges, the laſt is compoſed 17½ hoedts for corn, and 14½ for oats, equal to the laſt of Amſterdam.

At St. Omers, the laſt is reckoned 22½ raziers, the razier conſiſting of 2 ſcheppels.

At Dixmude, they reckon 30½ raziers to the laſt of wheat, and 24 for oats.

At L'Iſle, they reckon 41 raziers to the laſt of wheat, and 30 for oats.

At Gravelin, they reckon 22½ raziers to the laſt of corn, and 18¾ for oats.

Eighteen raziers of Dunkirk are equal to one hoedt of Rotterdam.

Of the LAST of LIEGE.

The laſt of Liege is compoſed of 96 ſextiers, of 8 muds each: they reckon the corn laſt of Tongres 15 muds, and that for oats but 14.

Of the LAST of GREAT BRITAIN and IRELAND.

The laſt of London conſiſts of 10½ quarters, or barrels, compoſed of 8 buſhels each, and the buſhel of 4 gallons.

The buſhel weighs between 56 and 60 lb. and 10 buſhels of England make about 1 laſt of Amſterdam.

In Scotland they reckon 38 buſhels to the laſt, and 18 gallons to the buſhel; and in Ireland the ſame thing.

Of

Of the LAST of DANTZICK.

At Dantzick they reckon 36 ſcheppels to the laſt, which is equal to 58 ſcheppels of Amſterdam.

They likewiſe reckon 16 ſchippondts to the laſt, and 340 lb. to the ſchippondt, which makes 5440 lb. to the laſt; but they give only 15 ſchippondts, or 5100 lb. weight, the laſt of oats.

They likewiſe divide their laſt at Dantzick into 16 ſextiers, meaſure of Paris, or 20 buſhels of Bourdeaux.

They buy and ſell their corn at Dantzick, as every other thing, by Poliſh florins and groſs.

Of the LAST of RIGA.

At Riga they reckon 46 loopen to be equal to the laſt of Amſterdam; and they buy and ſell it by rixdollars of 3 florins, or 90 Poliſh groſs.

Of the LAST of KONINGSBERG.

Six laſts of that place are equal to 7 of Amſterdam.

Of the LAST of COPENHAGEN.

They have there ſeveral laſts, which differ from one another conſiderably, according to the different ſorts of grain, or other commodities that are meaſured by them. Ricard makes mention of three ſeveral ſorts of laſts uſual in Copenhagen, viz. of 42 barrels, of 80 ſcheppels, and of 96 ſcheppels.

Of the LAST of STOCKHOLM.

At Stockholm they reckon 23 barrels to the LAST.

Of the LAST of HAMBURG, BREMEN, and EMBDEN.

The laſt of Hamburg conſiſts of 90 ſcheppels.

At Bremen they reckon 40 ſcheppels to the laſt; and 8 laſts of Bremen have held out to 7 laſts, 18 muds, and 1 ſcheppel at Amſterdam.

At Embden they reckon 15½ barrels to the laſt.

Of the MUID, *&c.* of FRANCE.

The principal meaſure made uſe of for grain, *&c.* at Paris, and moſt other places of the kingdom, is called *muid.*

The muid contains 12 ſextiers, and the ſextier 12 buſhels.

The ſextier of good wheat weighs between 244 and 248 lb. marc weight.

They divide the ſextier of oats into 24 buſhels, which again are ſubdivided into ſeveral ſmaller meaſures.

Nineteen ſextiers of Paris are reckoned equal to 1 laſt of Amſterdam.

The muid of Rouen contains 12 ſextiers, which are equal to 14 of Paris: it ought to weigh about 3360 lb. marc weight, and makes 28 buſhels of Bourdeaux.

Four muids of Rouen are reckoned equal to 3 laſts of Amſterdam.

The ſextier of corn weighs 210 lb. weight of Rouen, and is divided into two mines, and the mine into 4 buſhels.

The muid of Orleans ought to weigh 600 lb. and is compoſed of 12 mines, equal to $2\frac{1}{2}$ ſextiers of Paris, or 5 buſhels of Bourdeaux.

The meaſure made uſe of at Lyons, called *aſnée*, is divided into 6 buſhels, equal to $1\frac{1}{3}$ ſextier, meaſure of Paris, or $2\frac{1}{2}$ buſhels of Bourdeaux.

Eight buſhels of Rouen make 1 ſextier of Paris, and 2 buſhels of Bourdeaux.

The aſnée of Macon makes $1\frac{2}{3}$ ſextiers of Paris, or $3\frac{1}{3}$ buſhels of Bourdeaux.

The 5 buſhels of Avignon make 3 ſextiers of Paris, and 6 buſhels of Bourdeaux.

The ſextier of Montpelier is compoſed of 2 emines, and the emine of 2 quarters. The ſextier, weighing between 90 and 95 lb. weight of that town, being between 75 and 80 lb. marc weight; ſo that 100 ſextiers make 1 laſt 22 muds of Amſterdam.

The ſextier of Caſtres is compoſed of 2 emines, and the emine of 16 buſhels. The ſextier weighs about 200 lb. weight of that place, which is about 170 lb. marc weight; ſo that it may be reckoned that 1001 ſextiers of Caſtres make 4 laſts of Amſterdam.

The ſextier of Abbeville is compoſed of 16 buſhels, and is equal to that of Paris.

The ſextier of Amiens weighs from 50 to 52 lb. and 5 ſextiers.

The ſextier of Bologne weighs 270 lb. ſmall weight; and 8 ſextiers of that place render 5 of Paris.

The ſextier of Calais weighs 260 lb. and 12 of them render 13 of Paris.

Which

Which ſextier of Paris renders

At
- St Valery - - - - 1 ſextier.
- Dieppe - - - - - 18 mines.
- Havre de Grace - - - 5¼ buſhels.
- Amboiſe - - - - 14 buſhels.
- Saumur - - - - 1 buſhel.
- Tours - - - - 14 buſhels.
- Blois - - - 20 buſhels.
- Aubeterre - - - - 5 buſhels.
- Barbeſieux - - - - 5 buſhels.
- Periguex - - - - 5 buſhels.

The ſextier of Arles weighs only 93 lb. marc weight, and the load is 360 lb. weight of that country.

The load of Beaucaire is 2 *per cent.* greater than that of Arles.

The load of Marſeilles is compoſed of four emines, and weighs 300 lb. weight of Marſeilles, or thereabout, which make 243 lb. marc weight; 100 lb. of which make 123¼ lb. weight of Marſeilles; ſo that the emine weighs 75 lb. weight of Marſeilles.

The load of St. Giles's is 18 or 20 *per cent.* greater than that of Arles

The load of Tarſeon is 2 *per cent.* leſs than that of Arles.

The load of Toulon is compoſed of 3 ſextiers of that place, and the ſextier contains 1¼ emines, 3 of which make 2 ſextiers of Paris; or, otherwiſe, they reckon that the buſhel weighs 31 lb. and that 7¾ buſhels make one ſextier of Paris.

The tun of Auray in Britanny is reckoned 2200 lb.

That of Audierne 2300 lb.

That of Breſt is 2240 lb.

That of Hennebon 2950 lb.

Port Lewis the ſame.

Quinpercorentin the ſame

The tun of Nantes is compoſed of 10 ſextiers, and the ſextier of 16 buſhels: it weighs between 2200 and 2250 lb. the meaſure being heaped, and 18 or 20 *per cent.* leſs, if otherwiſe.

The tun of Rennes weighs 2400 lb.

That of St. Malo the ſame.

The tun of Brieux 2600 lb.

That of Rochelle and Maron 42 buſhels.

Of

Of Spain.

At Seville they reckon 4 cahies to a laſt, each cahy conſiſting of 12 anegras.

The fanegue of Cadiz weighs 93$\frac{1}{2}$ lb. weight of Marſeilles, 3$\frac{1}{3}$ lb. of which make the load of 300 lb. weight of Marſeilles aforeſaid, or 243 lb. marc weight.

Of Portugal.

At Liſbon they reckon 4 alguiers to the fanegue, 15 fanegues to the muid, and 4 muids to the laſt of Amſterdam.

Of Italy.

Grain is ſold at Genoa by the mine.

Two ſacks of wheat, at Leghorn, make 288 lb. weight of Marſeilles.

Corn is ſold at Venice by the ſextier, or ſtaro, which is the ordinary meaſure, 2 of which make a load of Marſeilles.

Of the chief Measures of Constantinople, and of the East Indies in general.

There being but about 3 *per cent.* difference betwixt the aunes of Amſterdam and picos of Conſtantinople, 100 aunes of Amſterdam make 103 picos of Conſtantinople; 100 picos of Conſtantinople make 97 aunes of Amſterdam.

Measures of Fort St George, or Madrass.

Grain Measures.

1 meaſure weighs about - - - 2 lb. 10 oz. Avoir.
8 ditto is 1 mercal - - - 21 —
3200 ditto is 400 ditto, or 1 garſe 8400 —

1 Madraſs rupee weighs 7 dwts. 11 gr. Troy, and is better than Engliſh ſtandard 14 dwts. 10 gr. in 1 lb.: it is country-touch 9$\frac{7}{8}$ China touch 98$\frac{1}{4}$.

Liquid and Dry Measures.

1 meaſure is equal to 1$\frac{1}{4}$ pint Engliſh of 423 cubic inches.
8 ditto are equal to 1 mercal of 3384 cubic inches.
400 mercals are equal to 1 garſe of 1,353,600 cubic inches.
1 covid is equal to 18$\frac{6}{10}$ inches.

N. B.

N. B. One meaſure weighs about 2 lb. 8 oz. Avoirdupoiſe.

Eight ditto weigh about 21 lb. or 22 lb.

3200 ditto is 400 mercals, or 1 garſe, which weighs 8400 lb. which is $3\frac{3}{4}$ tuns, or 100 Bengal baazar maunds of 82 lb. 2 oz. 2 dr. each.

Bengal Measures.

One meaſure is five ſeer.

Eight ditto are forty ſeer.

The covid (in cloth meaſure) is nine inches.

Of Malacca Measures.

A Malacca quoing is 3200 chupas, or 800 cantins, equal to 5000 Dutch pounds, or 5475 lb. Engliſh, or Canton peculs, (according to the Dutch calculation of 125 lb. to a pecul), 40 peculs.

A laſt is 2000 chupas, 500 cantins, 3000 Dutch pounds, 24 peculs, 3285 lb. Engliſh.

Anjengo Measure.

One Anjengo covid is eighteen inches Engliſh.

Callicutt and Tellicherry Measure.

One covid is eighteen inches Engliſh; and the Callicutt guz, made uſe of in meaſuring timber, is equal to $28\frac{2}{10}$ inches Engliſh.

They likewiſe, ſometimes at Callicut, meaſure their timber by the covid and borrebl; twelve borrebls is one covid when the timber is ſawed, and 24 borrebls is one covid when unſawed: the price generally is one Callicutt fanam *per* ſolid covid.

Carwar Measure.

One covid is eighteen inches Engliſh.

Surat Measures.

Are the larger and leſſer covid, *viz.*

One covid of 36 inches, and one covid 27 inches.

By the latter all things are ſold, except broad cloth, velvet and ſatin, which are ſold by the large covid, or Engliſh yard,

Gombroon

GOMBROON LONG MEASURE.

93 guz are equal to 100 yards Engliſh.

MOCHA MEASURES.

Rice, and other grain, are ſold by the kalla and tomand; forty kallas is one tomand, and weighs about 165 lb. but the governour's cuſtom (of half a kalla *per* tomand upon all grain ſold) being deducted, and the intolerable cheat in the meaſuring, together with the pilferage from the water-ſide home, being allowed for, the Bengal maund will not come out above nineteen kallas; whereas one bag, or Bengal maund, ought to hold out more than a tomand; but, for the forgoing reaſons, two Bengal maunds ſeldom come out above thirty-eight kallas, and rarely that.

Oil is ſold by the kudda, noosfia, and vakia.

Sixteen vakias is one noosfia.

Four noosfias, or meaſures, one cuddy poiſe, about 18 lb.

Of late years the price has been from three to five nooſfias *per* Mocha dollar; and, computing the dupper of two Bengal factory maunds to hold out about 67 or 68 meaſures each, at which rate, the noosfia, or meaſure, weighs about $2\frac{1}{2}$.

Cotton is ſold by the hearf, and nine hearfs is $11\frac{1}{4}$ Mocha dollars: it generally ſells from 30 to 40 hearfs *per* bahar.

LONG MEASURE.

The guz is twenty-five inches Engliſh.

The covid is nineteen inches Engliſh.

CHINA.

CANTON MEASURE.

Ten punts are one covid in piece-goods, equal to $14\frac{5}{7}$ inches."——Thus far from Poſtlethwayt's dictionary.

6. Time is a mode of duration, marked and aſcertained by certain unerring periods and meaſures, whereof the apparent motion and revolution of the ſun ſeems to be the principal. Hence the interval of time elapſed between the centre of the ſun's appearance on the meridian, and its return after one revolution to the ſame meridian again, hath been concluded on by all nations to be one day. Again, from the inſtant that the ſun is in the vernal equinox, or firſt degree of

of Aries, till it revolve round the ecliptic to the ſame point again, hath been found, from repeated obſervations, to contain 365 days and near $\frac{1}{4}$, and the time of this revolution is called a *tropical year*; which, as it did not amount to an exact number of entire days, but the fraction in 4 years would come little ſhort of a day; therefore every fourth year, called *biſſextile*, or leap-year, was made to conſiſt of 366 days, and the common years of 365 days.

The year, being thus eſtabliſhed, was divided as follows.

Seconds.
60= 1 minute.
3600= 60= 1 hour.
86400= 1440= 24= 1 day. h. min. ſec.
31556937=525949=8765=365 + 5+48+57=1 trop. year.

In almanacks, the year is divided into 12 calendar months, the names of which, and days they reſpectively contain, are immediately ſubjoined.

Months.	Days.	Months.	Days.	Months.	Days.
January,	31	May,	31	September,	30
February,	28	June,	30	October,	31
In leap year	29	July,	31	November,	30
March,	31	Auguſt,	31	December,	31
April,	30				

For ſome particular buſineſs, ſuch as payment of wages in the royal navy, they uſe the following table.

7 days = 1 week, 4 weeks = 1 month, and 13 months = 1 year.

CHAP. VII.

ADDITION OF APPLICATE NUMBERS.

RULE.

WHEN the numbers to be added are of one denomination, they muſt be placed and added as before: but when the denominations are diffe-

rent, like, or homogenial denominations, muſt ſtand in one column, ſo that there muſt be as many columns as there are denominations given, decreaſing from the left hand to the right, as in the ſubſequent examples. Then, beginning with the loweſt denomination, find its ſum as in whole numbers, out of which carry to be added with the next column, the units belonging thereto, and not what remains in its proper place; proceed through the whole in this manner, till you come to the integers, or higheſt place, which are added as before.

EXAMPLES IN MONEY.

L.	*s.*	*d.*
57456	15	$6\frac{1}{2}$
6478	19	$7\frac{3}{4}$
5745	17	$11\frac{1}{2}$
6785	14	$10\frac{1}{4}$
598	11	$11\frac{1}{2}$
678	10	$10\frac{1}{2}$
57	11	$10\frac{1}{2}$
98	14	$9\frac{1}{4}$
5	0	$8\frac{1}{2}$
6	9	$0\frac{1}{2}$
7	11	$9\frac{1}{2}$
77919	19	1 Upwards.
77919	19	1 Downwards.

I am indebted as follows; to how much will it amount?

	L.	*s.*	*d.*
To A.	74568	19	$11\frac{1}{2}$
To B.	54789	18	$10\frac{3}{4}$
To C.	4900	17	$11\frac{1}{2}$
To D.	578	18	$6\frac{1}{4}$
To E.	489	14	$7\frac{1}{2}$
To F.	584	15	$9\frac{3}{4}$
To G.	674	11	$8\frac{1}{2}$
To H.	495	0	$9\frac{1}{2}$
To I.	55	0	$0\frac{1}{2}$

ILLUSTRATION.

In the place of farthings expreſſed by the fractions on the right hand, in which $\frac{1}{2}$ is reckoned 2, I find 24, which is juſt 6d.; as there is nothing over to be noted, I carry the 6d. to the column of pence, in which, including the 6d. I find 97 pence, or 8s 1d. wherefore the penny falls to be noted down in the column of pence, and the 8s. carried to be added in with its proper column; in the units place of the column of ſhillings, the 8s. included, I find 49; wherefore, as in integers, I note 9, and carry 4 to be added with the 10's place, in which I find 13 tens = 6 twenties, and 1 ten, which is noted before the 9, and both together make 19s.; the

the L. 6 is carried to be added in with the units place of the pounds, which are added as integers.

OBSERVATION.

1. If the reaſon of addition of integers hath been properly attended to, the reaſon of the laſt operation will be pretty evident. For ſince 12 pence is equal to 1 ſhilling, it is plain that 97 pence is equal to 8 ſhillings, and 1 penny; wherefore, as it would be not only inconvenient, but really abſurd, to write ſhillings in the place of pence, no more falls to be noted in the place of pence, but the penny which is over the ſhillings, being truly a part of the next column, *&c.*

2. From the addition of the laſt example, it will appear very neceſſary that the foregoing tables be committed to memory, otherwiſe it will be impoſſible to add at all.

3. It will be found very convenient, in adding thoſe denominations, in whoſe units place you cannot ſtop by ten, as you did in the place of ſhillings of the laſt example, to make a table of the nature of thoſe ſubjoined, which is effected by multiplying the number in queſtion by 2, 3, 4, 5, *&c.* and commit theſe ſeveral products to memory, eſpecially in ſuch caſes as more frequently occur in practice.

4. Though the method of performing addition is perhaps as eaſily diſcovered as any other rule in arithmetic; yet, to add with accuracy, and at the ſame time with diſpatch, requires a conſiderable practice: I would therefore adviſe the young arithmetician, to take frequent exerciſes by himſelf of this kind, beginning at firſt but with a few lines, and increaſing that number as he becomes more expert. He ſhould at firſt add ſlowly figure by figure, and repeat the ſame column again and again, till he can take in 2, 3, or 4 figures at once: and by thus accuſtoming himſelf to addition, he will be able to perform in a few minutes, with abſolute certainty, what would otherwiſe take him up for hours.

TABLE of grains Troy.

Grains.		*dwt.*
24	=	1
48	=	2
72	=	3
96	=	4
120	=	5

TABLE of pounds Avoirdupoiſe.

Pounds.		*quarters.*
28	=	1
56	=	2
84	=	3
112	=	4
140	=	5

Grains Troy continued.

Grains.		*dwt.*
144	=	6
168	=	7
192	=	8
216	=	9
240	=	10
264	=	11
288	=	12

Pounds Avoirdupoiſe continued.

Pounds.		*quarters.*
168	=	6
196	=	7
224	=	8
252	=	9
280	=	10
308	=	11
336	=	12
364	=	13

The uſe of theſe tables is obvious.

I ſhall now give ſome examples of weights and meaſures. Thoſe in which there may appear no difficulty, ſhall be left for the learner's practice; ſuch as require illuſtration ſhall be added.

Troy Weight.

Pounds.	*oz.*	*dwts.*	*gr.*
472	11	19	22
534	10	14	21
647	11	18	21
348	10	17	18
246	11	19	12
347	11	13	19
618	5	15	17
947	9	17	11
64	8	8	9
9	7	11	15
5	4	10	16

Dutch Weight.

Stones.	*lb.*	*oz.*	*dr.*	*gr.*
475	15	14	13	34
568	14	13	15	23
647	13	12	11	32
954	12	11	13	31
876	9	14	15	29
678	10	11	12	28
578	11	10	13	27
485	14	13	15	24
657	11	11	7	28
6	4	0	6	0
5	9	9	0	19
5937	1	13	15	25

Apothecaries Weight.

Pounds.	℥	ʒ	℈	*gr.*
57	11	7	2	19
66	10	4	1	18
57	8	6	2	17
8	9	7	0	5
9	11	4	1	18
8	10	0	2	0
5	11	5	1	13
0	6	0	2	0
9	3	4	1	16
5	2	2	2	12
3	1	3	1	15

ILLU-

ILLUSTRATION.

In the example of Dutch weight, I find in the column of grains, whereof 36 = 1 drop, the ſum of 275; wherefore, diſcovering at once from my memory, or a mental diviſion, that 252 grains = 7 drops, the remaining 23 is noted down, and 7 carried to be added in with the drops in the next column, *&c.*

Note, One that is not much verſant in addition, had better add the denominations, conſiſting of two places, at twice, till he can do that very quickly; a little practice will enable him afterwards to add up two places of any denomination at once with the greateſt eaſe.

Avoirdupoiſe weight.

Tuns.	*cwt.*	*qu.*	*lbs.*
8745	19	2	27
4856	18	3	26
5479	14	1	25
3568	17	2	24
594	16	1	23
55	11	2	21

Wool weight.

Laſts.	*ſa.*	*w.*	*t.*	*ſto.*	*c.*	*lbs.*
87	11	1	$6\frac{1}{2}$	1	1	6
43	5	1	$3\frac{1}{2}$	1	1	4
6	4	1	$2\frac{1}{2}$	1	1	3
8	6	1	$3\frac{1}{2}$	1	1	5
17	2	1	$5\frac{1}{2}$	1	1	3
2	0	0	0	0	0	4
165	8	0	$5\frac{1}{2}$	1	0	4

Cloth meaſure.

Yds.	*qrs.*	*nls.*	*parts.*
45	3	3	15
30	2	1	12
67	1	2	13
8	3	1	14
9	2	2	11
7	2	3	12
8	1	1	10
9	2	0	9

Engliſh ſquare meaſure.

Acres.	*r.*	*p.*	*yds*	*feet.*	*inch.*
373	3	37	$27\frac{1}{4}$	6	115
485	2	38	$22\frac{1}{2}$	7	116
574	2	19	29	8	114
648	1	18	$18\frac{1}{2}$	5	125
741	2	17	$19\frac{1}{4}$	4	130
874	3	14	$2\frac{1}{2}$	3	134
878	1	18	30	5	116
6	3	17	15	6	117
4583	1	24	10	5	103

Note, In the above example of ſquare meaſure, I find the ſum of ſquare yards, including what I carried, to be $191\frac{1}{2}$, I then conſider that $6\times30=180+\frac{6}{4}=181\frac{1}{2}$, and the remainder eaſily occurs to be 10.

Scotch

Scotch ſquare meaſure.

Acre.	*rood.*	*fall.*	*ell.*
42	1	38	10
57	3	39	35
43	2	27	24
8	3	15	27
65	2	24	17
37	3	31	32
45	2	15	18

Long meaſure.

Miles.	*fur.*	*yds.*	*feet.*	*inch.*
3467	5	219	2	10
4567	7	184	1	11
5678	6	62	2	8
78967	4	9	0	9
56789	3	84	2	11
24608	2	147	1	10
35791	1	210	2	6
209871	0	80	0	5

In the example of long meaſure, the perches are neglected; and as there is no other intermediate denomination betwixt yards and furlongs, I carry at 220.

Wine-meaſure.

Tun	*hhd.*	*gall.*	*qu.*	*pints*
436	3	61	2	1
678	2	61	3	0
569	1	48	1	1
456	0	29	3	1
789	1	36	2	0
987	2	54	1	1
672	3	46	3	1
4591	1	24	1	1

Ale and beer-meaſure.

Hhd.	*bar.*	*kil.*	*fir.*	*gal.*
176	1	1	1	$8\frac{1}{2}$
374	$1\frac{1}{4}$	1	1	$7\frac{1}{2}$
842	1	0	1	6
374	$1\frac{1}{4}$	1	0	$5\frac{3}{4}$.
516	$0\frac{1}{2}$	1	0	$5\frac{1}{2}$
637	1	1	1	$6\frac{3}{4}$
591	1	1	1	8

Scotch dry meaſure.

Ch.	*b.*	*f.*	*p.*	*l.*
875	15	2	1	1
43	14	3	3	3
87	13	2	2	2
6	15	3	2	2
67	14	2	3	2

Engliſh dry meaſure.

Q.	*b.*	*p.*	*g.*
875	7	3	1
43	4	2	1
67	5	3	1
54	4	2	1
475	5	3	1

CHAP.

CHAP. VIII.

SUBTRACTION of applicate Numbers.

RULE.

PLACE the numbers, or denominations, homogeneal under homogeneal, and borrow according to the diviſion of the integer, as illuſtrated in ſome of the following examples.

	Money.			Troy weight.				Apothecaries weight.				
	L.	*s.*	*d.*	*lbs.*	*oz.*	*dwt.*	*gr.*	*lbs.*	℥	ʒ	℈	*gr.*
From	54	13	11¼	87	7	13	21	83	7	4	1	13
Take	35	15	8½	43	10	15	17	42	5	7	2	18
Reſts	18	18	2¾	43	08	18	4	41	1	4	1	15

ILLUSTRATION,

In the example of money, I cannot take ¾ from ¼, and therefore I take it from an unit of the next higher denomination, and to the remainder add the given ¼; thus 4 farthings −2+1=¾. I replace the unit I had thus borrowed, by adding it to 8 d. whence I had taken it. And indeed, it would have anſwered the end to have taken the difference betwixt 8½ and 11¼ d. at once, if it could upon all occaſions have been recommended to practice, as it would have brought out the ſame remainder.

Subtraction is ſo eaſy an operation, and the memory is ſo little burthened with it, that a farther illuſtration would be needleſs, and therefore I ſhall only ſubjoin a few examples for practice.

Dry meaſure.					Long meaſure.					Cloth meaſure.		
Laſt.	*wey.*	*qu.*	*b.*	*p.*	*M.*	*f.*	*p.*	*y.*	*feet.*	*Yds.*	*qrs.*	*nails.*
87	1	2	4	2	47	5	34	3¾	1	57	1	0
43	1	3	5	3	13	6	37	4¼	2	14	3	1

Avoirdupoiſe

Avoirdupoiſe weight.				Wine meaſure.				Ale meaſure.				
Tun.	*cwt.*	*qrs.*	*lbs.*	*Tuns.*	*p. hhds.*	*gal.*		*Bar.*	*f. gal.*	*q.*	*p.*	
75	7	3	17	75	1	0	35	43	1	5	2	0
69	14	3	19	68	1	1	50	29	1	7	3	1

Yarn.					Time.				
Sp.	*ha.*	*he.*	*c.*	*th.*	*Y.*	*d.*	*h.*	*m.*	*ſ.*
572	1	1	1	100	7415	199	14	50	40
69	1	5	1	115	897	270¼	19	50	52

Queſtions for practice in addition and ſubtraction.

1. A merchant, in balancing his books, finds he hath in ready money, L. 456, 17 s; in goods, L. 1749 : 19 : 6; his ſtock in a company-trade was L. 199 : 19 : 6½; due him in open accounts, L 2977 : 19 : 7¼; in bills, L. 647, 16 s; in ſhips and houſes, L 1976 : 14 : 7½; and in conſignments, L. 479 : 19 : 7. He owes to A, L. 1456 : 18 : 7½; to B, L. 99 : 19 : 11 : to C, L. 497 : 17 : 10; and to the bank, L. 490. What is his nett ſtock?

	L.	*s.*	*d.*		*L.*	*s.*	*d.*
Caſh,	456	17	0	He owed to A,	1458	18	7½
Goods,	1749	19	6	To B,	99	19	11
Company,	199	19	6½	To C,	497	17	10
Accounts,	2977	19	7¼	To the Bank,	490	0	0
Bills,	647	16	0				
Ships, &c.	1976	14	7½	Sum of his debt	2544	16	4¾
Conſign.	479	19	7				
Groſs ſtock,	8489	5	10¾				
Sum of debt	2544	16	4½				
Nett ſtock,	5944	9	6¼	Anſwer.			

2. A merchant hath a bill to pay of L. 500, for which he had prepared in caſh, L. 197, 19 s he hath a bill on Edin-

burgh for L 120; for how much muſt he draw on the bank to retire the bill of L 500?

Anſwer, L 182, 1s.

3. A farmer paid of yearly rent for his poſſeſſion L 156 17s. 8d; at the expiration of three years, when he was called to ſettle accounts with the landlord, he could produce receipts only for L 376 : 19 : $7\frac{1}{2}$. How much muſt he pay to even the account?

Anſwer, L 93 : 13 : $4\frac{1}{2}$.

4. Bought 8 hogſheads of raiſins, each weighing groſs 5 cwt 1 quarter, and 11 pounds; upon each hogſhead whereof I am allowed a deduction of 3 quarters and 21 lbs. What will be the nett weight?

Anſwer, 35 cwt. 1 quarter, 4 pounds.

5. A merchant ſent his clerk to a fair, where he bought linen to the amount of L 105 : 12 : 11; ſtockings to the amount of L 184 : 16 : 11; he recovered of accounts due the merchant to the amount of L 64, 10s; and got payment of a bill for L 129, 19s; he paid ſome few demands, amounting in all to L 19 : 19 : 11; his account of petty charges came to L 1 : 14 : 6; and he gave back to his maſter L 27 : 11 : 10. How much money had he got from the merchant before he ſet out?

Anſwer, L 135 : 7 : 1.

6. A caſtle was built in the year 1459; how old is it in the year 1769?

7 Received from Jamaica 103 tuns, 13 cwt. of logwood, by the happy Janet; of which I ſold to A, 15 tuns, 10 cwt. 3 qrs. 17 lb.; to B, the double of what I ſold to A; and to C, as much as I had ſold to A and B together. How much have I on hand?

CHAP. IX.

MULTIPLICATION of APPLICATE NUMBERS.

RULE.

WHEN theſe numbers are of different denominations, beginning the multiplication at the

right hand, carry, as in addition, one from each denomination to another, for as many as make an unit of the next ſuperiour order, and place the remainder under its proper denomination. A few examples will render this extremely plain.

Queſt. 1. What coſt 8 pieces of broad cloth, at L. 5 : 17 : 8 *per* piece?

L.	5	17	8	
			8	
L.	47	1	4	Anſwer.

2. What coſt 72 bags of cotton at L. 7 : 14 : 8 *per* bag?

L.	7	14	8	
			8	
L.	61	17	4	
			9	
L.	556	16	0	Anſwer.

3. What coſt 34 pieces of luteſtrings, at L 9 : 18 : 8 *per* piece?

L.	9	18	8 × 2	
			8	
	79	9	4	
			4	
	317	17	4	price of 32 pieces.
	19	17	4	price of 2 pieces.
	337	14	8	price of 34 pieces. Anſ.

4. What

4. What coſt 76 cwt. of ſhip-biſcuit, at 13 s. 6 d. per cwt?

	s.	d.		
	13	6	× 4	
		12		
L.	8	2	0	price of 12
			6	
	48	12	0	price of 6×12=72
	2	14	0	price of 4× 1= 4
	51	6	0	price of 76 Anſwer.

5. Sold 174 ingots of ſilver, each ingot weighing 15 lb. 11 oz. 19 dwt. 21 gr.; what is the weight of the whole?

lb.	℥.	*dwt.*	*gr.*	
15	11	19	21	
			10	
159	11	18	18	weight of 10.
			19	
1599	11	7	12	ditto of 10×10=100
1119	11	11	6	ditto of 7×10= 70
63	11	19	12	ditto of 4× 1= 4
2783	10	18	6	ditto of 174 Anſwer.

6. Bought 574 pounds of tobacco, at $7\frac{1}{4}$ d. *per* pound; what coſt the whole?

L.	0	0	$7\frac{1}{4}$	
			10	
	0	6	$5\frac{1}{2}$	value of 10 pounds.
			10	
	3	4	7	ditto of 10×10=100
			5	
	16	2	11	ditto 5×100=500
	2	5	$2\frac{1}{2}$	ditto of 7× 10= 70
	0	2	7	ditto of 4× 1= 4
L.	18	10	$8\frac{1}{2}$	ditto of 574 Anſwer.

These examples are sufficient for exhibiting all the necessary varieties in multiplication of mixed numbers, the more especially as the learner will find, in the rules of practice, methods that are in general much more expeditious, and less burthensome to the memory, for solving all questions of this kind; though in some cases, where a single multiplication, or perhaps two, are only necessary, this may be used with great propriety.

CHAP. X.

DIVISION of APPLICATE NUMBERS.

RULE.

IN dividing different denominations, the remainder of the integral part must be brought to the quality of the next inferiour denomination; and, if any of that denomination was given, it must be added to the product: then find how oft the divisor is contained therein, and the quotient will be of that denomination: if any thing still remain, proceed in the same way, as illustrated in the following examples.

Quest. 1. L. 34, 16 s. is to be divided among 5 men equally. What will fall to each?

5)34 : 16(6 : 19 : $4\frac{2}{5}$

30

4×20+16=96

5

46

45

1×12=12

10

2

Note,

Note, After a little practice, the laſt queſtion, or any other where the diviſor is ſmall, may be expeditiouſly done by a mental multiplication and ſubtraction. When the diviſor is great, the memory may be helped in the more burthenſome part of the work, by uſing a piece of waſte paper, or ſtill better by abbreviating the terms when poſſible.

The laſt example reſumed. 5)34 : 16 : 0

6 : 19 : $2\frac{2}{5}$

Note, When L. 34 is divided, the remaining L. 4, 16 s. will readily occur to be =96 s.; which, being partially divided, quotes 19 s. with 1 remaining = 12 d. of which $\frac{2}{5}$ = $2\frac{2}{5}$.

2. Bought 48 pieces of cloth for L. 256, 18 s. what did it coſt *per* piece?

8)256 18 0

6)32 2 3

5 7 $0\frac{1}{2}$ Anſwer.

3. Bought 375 pieces of Iriſh linen, for L. 701 : 15 : 3 freight and other charges came to L. 4 : 17 : 11. What did it coſt *per* piece?

L.	701	15	3
	4	17	11
5)	706	13	2
5)	141	6	$7\frac{2}{5}$
5)	28	5	4
3)	5	13	$0\frac{4}{5}$
	1	17	$8\frac{4}{5}$

Note, It will be ſufficiently exact to take the quotient of the fractions that is neareſt the truth; and, if you are above the juſt quotient at one time, be below it at another time, as in the laſt example.

4. If

4. If 60 gallons of water fall into a ciſtern that will contain 200 gallons, in the ſpace of an hour, and by a pipe in the ſame ciſtern there run out 45 gallons in the ſame time; how long will it take to be full in this caſe?

60—45=15)200

Hours 13, 20 minutes. Anſwer.

5. There is a legacy of L. 4753, 19s. to be divided among A, B, C, D, and E, in ſuch a manner, that for every ſhilling E takes up, D ſhall have two, C 3, B 4, and A 5; what will fall to each?

1+2+3+4+5=15)4753 19 0

316	18	$7\frac{1}{3}$	E's ſhare.
633	17	$2\frac{2}{3}$	D's ſhare =2 E's ſhare.
950	15	$9\frac{1}{3}$	C's ſhare =D+E.
1267	14	$4\frac{2}{3}$	B's ſhare =C+E.
1584	13	0	A's ſhare =B+E.
4753	19	0	Proof.

6. A gentleman, on his death-bed, leaving his wife pregnant, and an eſtate of L. 6666 : 13 : 4, ordered by his teſtament, that, if his wife bore a ſon, $\frac{2}{7}$ of the fortune ſhould go to that ſon, and the other $\frac{1}{7}$ to the widow: but, if ſhe bore a daughter, the widow ſhould enjoy $\frac{2}{7}$, and the daughter the remainder: ſhe had a ſon and a daughter at the ſame time: In this caſe, how will the fortune be divided?

By the teſtament the ſon was ſecured in double the widow's ſhare, and the widow in double the daughter's; therefore, the daughter's ſhare muſt be to the widow's as 1 to 2, and the widow's to the ſon's as 2 to 4.

Upon theſe principles it will be divided thus:

1+2+4=7)6666 13 4

952	7	$7\frac{3}{7}$	the daughter's ſhare.
		2	
1904	15	$2\frac{6}{7}$	the widow's ſhare.
		2	
3809	10	$5\frac{5}{7}$	the ſon's ſhare.
6666	13	4	as before.

7. A

7. A privateer takes a prize. value L. 20,000: the crew conſiſted of the captain, the lieutenant, the maſter, maſter's mate, ſurgeon, ſurgeon's mate, purſer, 4 midſhipmen, and 100 men: by the ſhip's regulations, the private men ſhared equally, a midſhipman had as much again as a private man, each mate the double of a midſhipman's ſhare, the ſurgeon and purſer drew each the double of a mate's ſhare, the lieutenant and maſter had each as much as the ſurgeon and purſer, and the captain as much as both lieutenant and maſter: According to theſe regulations, how will the prize be divided?

100+8+8+16+32+32=196)20.000

L. 10204	1	3 = 100 × - -	102	0	9 1/2	to each p. man.
816	6	6 = 4 × - -	204	1	7 1/2	to each midſhip.
816	6	6 = 2 × - -	408	3	3	to each mate.
1632	13	0 = 2 × - -	816	6	6	to the ſurgeon and purſer each.
3265	6	0 = 2 × - -	1632	13	0	to the lieutenant and maſter each.
3265	6	0 = 1 × - -	3265	6	0	to the captain.
0	0	9 loſt with the remainder.				
20000	•	• as before.				

The

The APPLICATION of MULTIPLICATION and DIVISION to ſquare and ſolid meaſures.

Queſt. 1. What is the ſquare contents of a room, 18 feet 8 inches by 14 feet 6 inches?

```
2)18  8
      7
-------
130  8
     2
-------
261  4 = 18  8 × 14
  9  4 = 18  8 ÷  2
-------
270  8  Anſwer.
```

2. What is the ſquare contents of a room, 12 feet 7 inches long and 11 feet 5 inches broad?

```
3)12  7
  11  5
-------
138  5  = 11 × 12  7
4)  4  2⅓ = 12 7 ÷ 3 for 4 inches.
    1  0 7/12 =  4 2⅓ ÷ 4 for 1 inch.
-------
143  7 11/12 Anſwer.
```

3. What is the ſolid content of a box, 5 feet 6 inches thick, 4 feet 4 inches broad, and 7 feet 3 inches long.

```
 7  3
 4  4
-------
29  0 = 7 3 × 4
 2  5 = 7 3 ÷ 3 for 4 inches.
-------
31  5 ſquare content.
 5  6
-------
157  1 = 31 5 × 5
 15  8½ = 31 5 ÷ 2 for 6 inches.
-------
172  9½ ſolid content.
```

4. There is a box 6 feet 6 inches long, 7 feet 9 inches broad, at one end, and 3 feet 7 inches at the other, and 4 feet 6 inches thick; what is its ſolid content?

7	9	one way.
3	7	the other way.
2)11	4	ſum of the breadths.
5	8	mean breadth.
6	6	
34	0	
2	10	
36	10	ſquare content
4	6	
147	4	
18	5	
165	9	ſolid content.

CHAP. XI. REDUCTION.

REDUCTION converts one denomination, or ſpecies, into another, without altering the value.

RULE I.

To reduce numbers of a higher denomination to numbers of the ſame kind of an inferior denomination, multiply by as many of the inferior denomination as makes one of the greater.

RULE II.

To reduce numbers of a lower denomination to numbers equivalent of a higher denomination, divide by as many of the inferior as makes one of the greater.

EXAMPLES.

(1.)

Reduce *L* 760 to farthings.

20

15200 ſhillings.

12

182400 pence.

4

729600 farthings.

(2.)

Reduce 729600 farthings to pounds.

4)729600

12)182400 pence.

20)15200 ſhillings.

760 pounds.

(3.)

lb.	*oz.*	*dwt.*	
In 74	11	15	Troy, how many [grains?

12

899 ounces.

20

17995 dwts.

24

431880 gr.

(4.)

In 431880 grains, how many pounds Troy?

4)431880

6)107970

20)17995 dwts.

12)899 15 oz.

74 11 15 Anſ.

More examples of this kind of reduction would be unneceſſary, as the reaſon and manner of the operation muſt be obvious.

RULE III.

To reduce one ſpecies into its equivalent of another, when the one is no even part of the other,—— multiply the given number by the value of an unit of the ſame ſpecies expreſſed in the loweſt name mentioned in the queſtion, and divide that product by the value of an unit of that ſpecies which is required, expreſſed in the ſame name.

Queſt.

Queſt. 1. I have ſent 345 bank-notes. each 20 s. to be exchanged for guineas; how many guineas will compenſate the notes?

345
20

3)6900

7)2300

328 guineas and 12 s or $\frac{4}{7}$ of a guinea.

2. I want to exhange for guineas, 360 five-pound notes, 150 ten-pound notes, and 27 ten-ſhilling notes; what number of guineas ought I to receive?

360× 5=1800
150×10=1500
27÷ 2= 13 10

21)3313 10
157 15

Guineas 3155 15 ſhillings. Anſwer.

3. I have 1478 moidores, worth 27 s. each, which I would exchange for piſtoles at 16 s. 6 d. each; how many piſtoles ſhould I have in return?

Firſt, 27 s. = 54 ſixpences, the loweſt name mentioned, and 16 s. 6d. =33 ſixpences.

But 54 and 33 are each commenſurable by 3, and quote 18 and 11.

Therefore, 1478 moidores.
18

11)26604

2418$\frac{6}{11}$ piſtoles. Anſwer.

4. How many French crowns, at 31$\frac{1}{2}$ d. may I have in exchange for 37542 guilders. at 21$\frac{1}{2}$ d. ?

21×4+1 = 37542
85 farthings in a guilder.

187710
300336

31×4+2=126) 3191070

21) 531845 the quotients of both factors by 6.

7) 177281½ ditto.—Ditto by 3.

25325½ French crowns. Anſwer.

5. In 87547 ducats, at 3s. 9d, how many Hamburg marks, at 1s. 6d.?

s.	d.
3	9
4	

3)15 threepences.

5 ninepences

1 6
4

3)6 threepences.

2 ninepences.

87547
5 ninepences.

2)437735

218867½ marks of Hamburg.

After a little practice, multipliers and diviſors may be abridged mentally, without any formal multiplication or diviſion: for, in the laſt inſtance, it will eaſily occur that there are 5 times 9 pence in 3s. 9d. and 2 ninepences in 1s. 6d.

6. If I had 4754 livres in France, which I rate at 10½d. each, how many milrees of Portugal, at 5s. 3d. would they anſwer for?

10½d. is contained in 5s. 3d. juſt 6 times.
Therefore 6)4754

792⅔ milrees. Anſwer.

7. In

7. In L. 4754, 19 s. how many guineas, crowns, ſhillings, and ſixpences, of each an equal number.

4754 19
20
95099
2
42+10+2+1=55) 190198
11) 38039$\frac{1}{11}$ abridged by 5.
3458$\frac{5}{11}$ of each ſpecies.

8. If I had guineas 90 ſcore, and crowns juſt 92; In place of 39 hundred pounds, what money would be due?

90×21= 1890 *l.*
92÷ 4= 23
Take *L.* 1913 in the guineas and crowns.
From 3000
Remains 1087 due.

In the country, particularly in the north of Scotland, they keep their accounts in Scotch money, the pound of which is $\frac{1}{12}$ of a pound Sterling, and divided in the ſame manner. In making bargains, and ſometimes in granting bonds, they expreſs their money in merks, one of which is 13 s. 4 d. or $\frac{2}{3}$ of their pound. Hence, to reduce pounds Scots to merks, multiply by 3, and divide by 2; and to reduce merks to pounds, multiply by 2, and divide by 3. Again, ſince the merk is to the pound Scotch as 2 to 3, and the pound Scotch to the Engliſh as 1 to 12, the Scotch merk will be to the pound Sterling as 1 to 18.

Theſe diſtinction are never uſed among merchants,

9. I have a bond for 5000 merks Scotch, a bill for L. 559 Scotch, and 24 crown-pieces; what are theſe worth in Sterling?

2)5000

2)5000 merks

9)2500

L. 559 Scots.

	277	15	$6\frac{2}{7}$	value of the bond.
12 =	46	11	8	ditto of the bill.
24 ÷ 4 =	6	0	0	ditto of the crowns.
	330	7	$2\frac{2}{7}$	value of the whole.

10. Two merchants, A and B, had been long in a company-trade; A's ſhare of the concern was to B's as 4 to 1: When circumſtances rendered it neceſſary for them to wind up and ſeparate, the ſtate of their affairs was as follows. Their caſh and other effects, by an inventory, amounted to L. 5000; bills and open accounts, in Britain, to L. 1300; Holland was indebted to them in nett proceeds of tobacco, for 7485 guilders, at $21\frac{1}{4}$ d.; and Dunkirk in crowns 7456, at $31\frac{1}{4}$ d.; they were due in Britain L. 3754, and in Hamburg 7315 marks, at 1 s. 7 d.: Required their nett ſtock, and a partition thereof, according to each partner's original input.

They had effects, *per* inventory,

valued at - -	*L.* 5000					
Bills and open accounts, in Britain, for - - -	1300	0	0			
7485 guilders, at $21\frac{1}{4}$ d. =	658	16	$8\frac{1}{2}$			
7456 crowns, at $31\frac{1}{4}$ =	970	16	8	*L.*		
				7929	13	$4\frac{1}{4}$
They were due in Britain	3754	0	0			
In Hamburg 7315 marks, at 19 d.	579	2	0	4333	2	
Nett ſtock	4 + 1 = 5)			3596	11	$4\frac{1}{4}$
B draws				719	6	$3\frac{3}{20}$
A draws				2877	5	$1\frac{2}{20}$

11. In 1000 ale-gallons Scotch meaſure, how many Engliſh.

103 ſolid inches in a Scotch pint.
8

282)824000

2922 nearly.

12. Suppoſe

12. Suppose the distance betwixt Glasgow and London 330 miles, how oft will a coach-wheel turn round, whose circumference is 6 yards, in driving that distance?

Miles. Fur.

$$\frac{330 \times 8 \times 220}{6} = 96800 \text{ times. Answer.}$$

13. In $25\frac{3}{4}$ French acres, how many English?

$$\begin{array}{r} 52\frac{3}{4} \\ 4 \\ \hline 103 \\ 19 \\ \hline 4)1957 \\ \hline 4)\ 489\frac{1}{4} \\ \hline 4)\ 122\frac{5}{16} \\ \hline 30\frac{37}{64} \text{ or } 30\frac{1}{2} \text{ nearly.} \end{array}$$

14. Constantinople lies 1500 geographical miles S. E. of London, what is the distance in statute miles?

$$\begin{array}{r} 150069\frac{1}{2} \\ \hline 103500 \\ 750 \\ \hline 6,0)10425,0 \\ \hline 1737\frac{1}{2} \text{ Answer.} \end{array}$$

15. Quebec lies 300 geographical miles N. W. of Boston, what is the distance in French leagues?

$$\begin{array}{r} 300 \\ 5 \\ \hline 12)1500 \\ \hline 125 \text{ Answer.} \end{array} \qquad 5\Big)\begin{array}{l}25\\60\end{array}\Big(\frac{5}{12}$$

Questions

Queſtions of this nature might be multiplied to any length but it is preſumed there is a ſufficient variety in the foregoing for the improvement of the ingenious.

CHAP. XII. OF NUMBERS.

NUMBER in general may be defined, A collection or aſſemblage of ſeveral units, or ſeveral things of the ſame kind. Sir Iſaac Newton conceives number to conſiſt, not in a multitude of units, as Euclid defines it, but in the abſtract ratio of a quantity of any kind to another quantity of the ſame kind, which is accounted as unity; and, in this view, he divides number into three different kinds, integer, fraction, and ſurd.

Integers, whole or natural numbers, are all the various aſſemblages of unity, or the ideas we have of ſeveral multitudes.

Fractions are the diviſions or ſubdiviſions of unity, to which they refer, as a part doth to the whole.

Rational numbers are ſuch as are commenſurable with unity, or whereof unity is an aliquot part.

Surd, or irrational numbers, are ſuch as are incommenſurable with unity.

Even numbers are thoſe which may be divided into two equal parts, without any remainder, as the numbers 6, 8, 10, 12, &c. which have likewiſe theſe properties, that the ſum difference and product of even numbers, will each be an even number.

Uneven numbers, or ſuch numbers as cannot be divided into two equal parts without a fraction, have theſe properties, that the ſum or difference of two uneven numbers will be an even number, but the product will be an uneven number. If an even number be added to an uneven number, or if the one is ſubtracted from the other, the ſum in the one caſe and the remainder in the other will be uneven; but if they are multiplied, the product will be even.

A prime number is ſuch as hath no meaſure but itſelf and unity, and which of conſequence can be the product of no other numbers, as 2, 3, 5, 7, 11. Numbers prime to one another are ſuch as have no meaſure common to both but unity, as 12 and 19; for though both 3 and 4, or 2 and 6, will meaſure 12, yet neither of theſe will meaſure 10.

Compoſite

Compoſite numbers are ſuch as are diviſible by ſome number beſides unity, as 8 diviſible by 4, and by 2.

Numbers compoſite to one another have ſome meaſure common to each beſides unity, as 12 and 15 diviſible by 3.

A number that can divide ſeveral numbers exactly, is called a *common meaſure*, as in the laſt inſtance 3 is a common meaſure to 12 and 15.

Prob. 1. To find the greateſt common meaſure to any numbers propoſed, add all the propoſed numbers, excepting the leaſt, which is reſerved for a diviſor. If there is no remainder, after the ſum of the greater numbers hath been divided by the leaſt, then that diviſor is the common meaſure; but, if there is a remainder, it becomes a new diviſor, and the laſt diviſor becomes a new dividend, *&c.* the laſt diviſor, which left no remainder, is the common meaſure.

What is the greateſt common meaſure of 8, 16, 24, and 32?

16
24
32
8)72

9 without a remainder: So 8 is the greateſt common meaſure for $\frac{8}{8}=1$, $\frac{16}{8}=2$, $\frac{24}{8}3$, and $\frac{32}{8}=4$.

What is the greateſt common meaſure of 12, 16, 24, 36, and 52?

16
24
36
52
12)128

10 rem. 8|12
1 rem. 4|8
2 and 0 remains.

Conſequently 4 is the greateſt common meaſure.

Note, If only two numbers were propoſed, the greater is divided by the leſſer, *&c.* Hence any number not exceeding the leaſt of ſeveral numbers that can meaſure their ſum, will meaſure them all ſeverally.

Prob. 2. To find the leaſt common multiple of ſeveral

numbers. Write the numbers in a line, and divide them by 2, 3, or any other numbers which will measure two or three of them exactly; place the quotients with the numbers undivided below, and divide them continually till their quotes be 1: Then the product of all the divisors multiplied continually, is the least common multiple required, which, if they were primes to one another, will be the continual product of the given numbers.

What is the least common multiple of 6, 12, 24, 36?

6	6 . 12 . 24 . 36	
2	1 . 2 . 4 . 6	6×2×2×3=72
2	1 . 2 . 3	
3	1 . 3	
	1	

There are other problems which might have got a place here, but these I reckon sufficient for my purpose.

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PART II.

OF FRACTIONS.

I. OF VULGAR FRACTIONS.

INTRODUCTION.

A VULGAR FRACTION is a part, or parts of an integer arising from diviſion, and ſtands to an unit in the relation that a part doth to the whole.—Of thoſe parts the numerator expreſſeth the number, as $\frac{3}{4}$ and the denominator the quality, as

Hence the denominator ſuppoſeth the integer to be divided into 4 equal parts; for inſtance, 1 yard into 4 quarters: and the numerator aſcertaineth the number of thoſe parts to be 3; and the fraction is accordingly read three fourths, or quarters of 1.

Since the denominator repreſents all the parts into which the integer is divided, and the numerator the number of thoſe parts expreſſed by the fraction, it muſt follow, that, if the numerator be leſs, equal to, or greater than the denominator, the quantity repreſented by the fraction muſt be leſs equal to, or greater than the integer accordingly. Hence, if the numerator is leſs than the denominator, the fraction is called *proper*, and repreſents ſomething leſs than the integer, as $\frac{1}{4}$, $\frac{1}{12}$, $\frac{1}{7}$, *&c.*

If the numerator is equal to, or greater than the denominator, the fraction is called *improper*, and repreſents ſomething equal to, or greater than the integer, as $\frac{4}{4} = 1$, $\frac{5}{4} = 1\frac{1}{4}$, *&c.*

Since an integer may be divided into any number of parts, each of theſe parts may be again ſubdivided, and each of

theſe ſubdiviſions again, *ad infinitum*; as a pound is divided into 20 ſhillings, each of theſe ſhillings into 12 pence, and each of theſe pence into 4 farthings. Hence, 3 farthings would be expreſſed fractionally $\frac{1}{4}$ of $\frac{1}{12}$ of $\frac{1}{20}$ and ſuch fraction would be called a *compound fraction*.

Since any of the denominations, or parts of an integer, can be expreſſed fractionally, a fraction annexed to an integer will expreſs the ſame thing as its equivalent denomination. Hence L. 4, 10 s. ſince 10 s. repreſents 10 of 20 parts of a pound, may be wrote $4\frac{10}{20}$ and ſo called a *mixed number*.

Obſervation 1. Thoſe fractions are equal to each other, whoſe numerators have the ſame relation to their denominators, $\frac{1}{6}=\frac{4}{8}=\frac{5}{10}=\frac{6}{12}=\frac{14}{28}=\frac{1}{2}$. For as all fractions ariſe from remainders in diviſion, when the diviſor can no longer meaſure the dividend, ſo every fraction may be conſidered as the two given terms of a diviſion, the numerator as the dividend, and denominator as the diviſor: Conſequently, if the numerator and denominator of a fraction be either multiplied or divided both by the ſame number, the products or quotients will ſtill remain in the ſame proportion, and the numerator of the new fraction bear the ſame relation to its denominator as it did in its former ſtate.

2. Fractions having a common denominator, are greater or leſs as their numerators, as $\frac{4}{7}$ repreſents a greater part of a quantity than $\frac{3}{7}$.

3. Of fractions whoſe numerators are equal, that which hath the leaſt denominator repreſents the greateſt part, as $\frac{3}{4}$ of a yard repreſents 3 quarters, and $\frac{3}{16}$ only 3 nails.

4. If two fractions are equal, the numerators multiplied into each other's denominator reſpectively, will make the products equal.——Suppoſe $\frac{2}{4}=\frac{1}{2}$, then $2\times2=4$, and $4\times1=4$.

CHAP. I.

REDUCTION of VULGAR FRACTIONS.

Prob. 1. To expreſs a whole number fractionally.

The given integer will be the numerator, and unity the denominator: Thus $\frac{5}{1}$, $\frac{6}{1}$, *&c.*; becauſe to divide 5 by 1, the quotient will be 5, *&c.*

Prob. 2. To reduce a mixed number to an improper fraction.

To

To the product of the integer and denominator multiplied add the numerator; the ſum ſhall be the numerator of the improper fraction, whoſe denominator ſhall be that of the fraction given.

Exam. $4\frac{3}{7}=4\times5+4=\frac{2}{7}\frac{4}{7}$; and $5\frac{1}{6}=5\times6+5=\frac{3}{6}\frac{1}{6}$.

Obſerv. The reaſon of this operation is evident; for the multiplication of the integer into the denominator + the numerator, expreſſes in the product all the parts contained in both, and the ſame denominator being again applied, the quality of thoſe parts is the ſame.

Prob. 3. To reduce an improper fraction to a whole, or mixed number.

Divide the numerator by the denominator, and to that quotient annex the remainder, if any, with the diviſor for the fractional part.

Exam. $\frac{2}{7}\frac{4}{7}=4\frac{4}{7}$, and $\frac{1}{8}\frac{7}{8}=5\frac{7}{8}$.

This is the reverſe, and conſequently an additional proof of the former problem.

Cor. Hence it will be obvious, that, to reduce an integer to an improper fraction of an aſſigned denominator, we have only to multiply the integer into the aſſigned denominator, and the product will be the numerator required. For inſtance to change 8 into a fraction whoſe denominator is 7 $8\times7=\frac{5}{7}\frac{6}{7}$ *&c.*

Prob. 4. To reduce a compound fraction to its equivalent ſimple one.

The continued product of all the numerators will be the numerator, and the continued product of all the denominators will be the denominator required.

Ex. $\frac{3}{4}$ of $\frac{4}{5}$ of $\frac{3}{7}=\frac{3\times4\times3}{4\times5\times7}=\frac{3\frac{6}{8}}{1\frac{4}{0}}$, and $\frac{1}{2}$ of $\frac{3}{4}$ of $\frac{5}{8}=\frac{1\times3\times5}{2\times4\times8}=\frac{1\frac{5}{6}\frac{5}{4}}{}$

Obſervation. The continued multiplication of the numerators and denominators reſpectively, brings each to the quality of the loweſt name: for, to expreſs 9 d. as the fraction of a pound, it would be $\frac{9}{240}$, becauſe there are 240 pence in a pound; if we conſider it as a compound fraction, as it really is, it will be expreſſed $\frac{9}{12}$ of $\frac{1}{20}$, which, by the rule, $=\frac{9}{240}$, as before.

Cor. Hence all the known ſubdiviſions of an integer may be expreſſed in compound or ſimple fractions at pleaſure.

Prob.

Prob. 5. To reduce fractions having different denominators to other equivalent fractions, having a common denominator.

The continued product of each numerator into all the denominators but its own, will give correſpondent numerators, and the continued product of the denominators will give a common denominator.

Exam. 1. $\frac{3}{5}$ $\frac{1}{2}$ $\frac{4}{7}$, thus $\left.\begin{matrix}3\times2\times7=42\\1\times5\times7=35\\4\times2\times5=40\end{matrix}\right\}$ Numerators.

Therefore $\frac{3}{5}=\frac{42}{70}$ $5\times2\times7=70$ Common denominator.

$\frac{1}{2}=\frac{35}{70}$

$\frac{4}{7}=\frac{40}{70}$, as required.

Exam. 2. $\frac{3}{4}$, $\frac{5}{6}$, and $\frac{1}{2}$ of $\frac{2}{3}$. Firſt, $\frac{1}{2}$ of $\frac{1}{3}=\frac{1}{6}$ in Ex. 2, Then $\frac{3}{4}$ $\frac{5}{6}$ $\frac{1}{6}$, the given fractions, which by the rule will produce $\frac{18}{144}=\frac{3}{24}$ $\frac{120}{144}=\frac{5}{6}$, and $\frac{24}{144}=\frac{1}{6}$, or $\frac{1}{6}$ of $\frac{1}{2}$.

Exam. 3. $\frac{5}{9}$, $\frac{6}{10}$, and $6\frac{1}{7}$, When $6\frac{1}{7}$ is made an improper fraction, $\frac{43}{7}$, $\frac{5}{9}$ by the rule will be $=\frac{315}{441}$, $\frac{252}{441}=\frac{270}{420}$, and $\frac{43}{7}=\frac{2709}{441}$.

Obſ. The reaſon of this problem is obvious; for, ſince the numerator and denominator of each fraction is equally multiplied, *viz.* by the denominators of all the other fractions, conſequently the fractions produced muſt be equivalent.

Prob. 6. To reduce a given fraction to another equivalent, having an aſſigned denominator when poſſible.

This is only an abbreviation of the laſt problem in poſſible caſes, and may be done by multiplying the numerator by the aſſigned denominator, and dividing that product by the old denominator, the quotient, if there is no remainder, will be the numerator required.

Exam. $\frac{2}{3}$ to a fraction whoſe denominator is 6. Thus, $2\times6=\frac{4}{6}$

3

Note, In addition of money, the different reckonings by Scotch and Engliſh will occaſion fractions of different denominators, to be annexed in the column of pence, as 4ths, 3ds, and 6ths; but theſe are very expeditiouſly added, by conſidering 12 as the common denominator; in which caſe, $\frac{1}{4}=\frac{3}{12}$, $\frac{1}{2}=\frac{6}{12}$, $\frac{1}{3}=\frac{4}{12}$, *&c.*

Prob. 7. To reduce a fraction to lower terms when poſſible.

Divide

Divide both numerator and denominator by any number that will measure both without a remainder; but, if nothing but unity is the same measure of both, the fraction is already in its lowest terms.

Hence even numbers may be divided by 2 continually, while possible. Numbers with ciphers may have an equal number cut off from each, and afterwards divided when possible.

Numbers ending in 5s, or 5 and cipher, may be divided by 5.

By a little practice, a common measure will readily occur for divisible numbers.

Exam. $5|\frac{365}{455}=\frac{73}{91}$. $2|\frac{26}{73}=\frac{13}{[illegible]}$. $3|\frac{1500}{1800}=\frac{5}{6}$. and $9|\frac{18}{27}=\frac{2}{3}$.

Prob. 8. To bring a fraction of a higher denomination to an equivalent fraction of a lower.

Reduce the numerator to the name required for the numerator of the new fraction, the denominator will be the same as before.

Exam. $\frac{5}{7}$ l. to the fraction of a sixpence; thus,

$$5\times\overset{s.}{20}\times\overset{6ds.}{2}=\frac{200}{7}$$

$\frac{3}{5}$ of a guinea to the fraction of a farthing, $3\times\overset{s.}{21}\times\overset{d.}{12}\times\overset{q.}{4}=\frac{3024}{5}$

Prob. 9. To reduce the known parts of a relative unit to the equivalent fraction of that unit.

This was formerly taken notice of in the corollary of prob. 4. and it is only resumed here for further illustration, to those who may find it still necessary.

Reduce all the given parts to the lowest mentioned, for a numerator, and the integer into the same name for a denominator.

Exam. 5s. $7\frac{1}{2}$d. to be expressed fractionally, $5\times12+7\times2+1=135$
$20\times12\times2=480$

Prob. 10. To value fractions in the known parts of the integer.

This is the converse of the last problem, and hath been exemplified in division, but still it may not be improper to give the rule.

Multiply the numerator by the parts of the next inferiour denomination, and divide the product by the denominator; the

the quotient ſhews the parts of that denomination, and the remainder becomes a new numerator, which muſt be valued as before, *&c.* till the fraction is brought to the loweſt known name of the integer.

Exam. Value $\frac{135}{480}$ l.

135
20
——*s. d.*
480)2700(5 $7\frac{1}{2}$ as above.
2400
——
300
12
——
3600
3360
——
240
4
——
960
960
——
0

Value $\frac{7}{12}$ of cwt.

7
4
——*qr. lb. oz.*
12)28 (2 9 $5\frac{1}{2}$
24
——
4
28
——
112
108
——
4
16
——
64
60
——
4

CHAP. II.

ADDITION of VULGAR FRACTIONS.

RULE.

REDUCE all the given fractions to ſimple fractions of the ſame integer and denominator, if not ſo already; then the ſum of the numerators with the common denominator, will be the fractional ſum required, which may be reduced to a mixed number, valued or expreſſed in ſhorter terms, as ſeems moſt expedient, or the caſe will admit.

EXAMPLES.

Add $\frac{3}{7}+\frac{4}{7}+\frac{5}{7}$ $3+4+5=\frac{12}{7}=1\frac{5}{7}$. Here 7 is a common denominator.

Add $\frac{3}{5}$, $\frac{1}{2}$, and $\frac{2}{3}$.

$$\begin{array}{l} 3\times2\times3=18 \\ 1\times5\times3=15 \\ 2\times5\times2=20 \\ \hline \quad 53 \text{ numerator.} \\ 5\times2\times3=30 \text{ denominator.} \end{array} = 1\tfrac{23}{30}$$

Add $\frac{3}{5}$ s. to $\frac{3}{5}$ l. First, $\frac{3}{5}$ s. $=\frac{3}{5}$ of $\frac{1}{20}=\frac{3}{100}$.

Then $3\times100+5\times3=315=\frac{63}{100}$.

And $5\times100=500$.

Add L. 4 : 15 : 6, and L. 3, $\frac{7}{8}$. First, 15 s. 6 d. $=\frac{31}{40}$

Therefore, $7\times40=280$

$$\begin{array}{r} 31\times8=248 \\ \hline 528 \\ \hline 8\times40=320 \end{array} = 1\tfrac{208}{320}$$

$$\begin{array}{r} 3 \\ 4 \\ \hline 8\tfrac{208}{320} \end{array}$$

Obs. If reduction is well understood and remembered, the addition of fractions will be very easy; the reason of which will be obvious, if we consider that the given fractions being such, or reduced to such a state, that all the numerators represent things of the same denomination, both absolute and relative, their sum must therefore be a number of such parts as the common denominator expresses of the same common integer.

CHAP. III.

SUBTRACTION OF VULGAR FRACTIONS.

RULE.

REDUCE the given fractions to simple ones of the same integer and denominator, as in addition,

and the difference betwixt the numerators, with the common denominator, will be the fractional difference required.

EXAMPLES.

(1.) $\frac{4}{5}-\frac{3}{5}=\frac{1}{5}$ (2.) $\frac{5}{6}-\frac{3}{4}$ $5\times4=20$ $6\times3=18$ $\frac{2}{12}=\frac{1}{12}$ $6\times4=24$ (3.) $\frac{3}{4}$l. $-\frac{3}{4}$s. $=\frac{57}{80}$ For $\frac{60}{80}-\frac{3}{80}=\frac{57}{80}$

(4.)

$L.\,4\frac{1}{2}-L.\,3\frac{3}{8}=1\frac{3}{7}$. For $4\frac{1}{6}-3\frac{1}{8}=1\frac{1}{7}$, &c.

The reason of this rule will be evident from the last observation.

CHAP. IV.

MULTIPLICATION OF VULGAR FRACTIONS.

RULE.

REDUCE the given fractions to their simple expression, if not so before, and to improper fractions, if mixed numbers, then will the product of the numerators and denominators respectively give the product required.

EXAMPLES.

(1.) $\frac{3}{5}\times\frac{5}{6}=\frac{15}{30}$, or $\frac{1}{2}$. (2.) $5\frac{5}{6}\times3\frac{3}{4}=\frac{35}{6}\times\frac{15}{4}=\frac{525}{24}$:

(3.) $\frac{3}{4}$ of $\frac{5}{6}\times\frac{7}{4}$ of $\frac{1}{3}=\frac{15}{24}\times\frac{1}{12}=\frac{15}{288}$.

(4.) $\frac{3}{4}$s. $\times\frac{1}{2}$l. $=\frac{3}{80}\times\frac{1}{2}=\frac{3}{160}$

OBSER.

OBSERVATION.

The operations in this rule are ſo ſimple, that more examples will be unneceſſary.

It is worth while however to obſerve, that multiplication of fractions at firſt ſight, would ſeem to contradict the definition of multiplication given in the firſt part. But this difficulty will evaniſh, if we conſider that the more any integral number is increaſed, the farther is the figure in the higheſt place removed from unity, and the more any part of an integer is decreaſed, the farther will its value alſo be removed from its relative unit; conſequently, as it is the nature of integers to increaſe, and of fractions to decreaſe, the purpoſe of multiplication is equally anſwered in both caſes. But, to be plainer ſtill, we had inſtances in the application of multiplication and diviſion to ſquare and ſolid meaſure, that a part of the multiplicand was taken when we wanted to multiply by a part of a foot; for this reaſon, To multiply by 1, would give the multiplicand for the product, and to multiply by any part of 1, can give but that part of the multiplicand for the product which the fraction expreſſeth.

CHAP. V.

DIVISION OF VULGAR FRACTIONS.

RULE.

PREPARE the fractions as in multiplication, then place the denominator of the diviſor above the ſeparating line, and the numerator below it, work as in multiplication, and the products ſo found will be the quotient.

EXAMPLES.

(1.) Divide $\frac{3}{5}$ by $\frac{1}{7}$. Thus, $\frac{1}{7})\frac{3}{5}(\frac{21}{5}$.

(2.) $\frac{4}{7}$ by $\frac{1}{4}$ of $\frac{3}{7}$. $\frac{21}{2})\frac{4}{7}(\frac{8}{147}$.

(3.) $4\frac{1}{6}$ by $2\frac{2}{5}$. $\frac{5}{12})\frac{29}{6}(\frac{145}{72}$.

(4.) $4\frac{3}{7}$ by $1\frac{3}{4}$ of $\frac{8}{11}$. $\frac{8}{11})\frac{31}{7}(\frac{248}{77}$.

Obſ. 1. Mixed numbers may be divided by mixed numbers, with as much brevity, and perhaps more intelligibly, eſpecially in applicate caſes, by the following rule.

Reduce the diviſor to an improper fraction, whoſe numerator will be a new diviſor, the quotient ariſing therefrom multiplied into the old numerator will give the fractional part of the quotient; and, being multiplied into the denominator, will give the quotient due to unity.

An example will illuſtrate this.

Suppoſe L. 478 : 19 : 6 were to be divided among 3 men, who were to have equal ſhares, and a boy who was to get only $\frac{1}{3}$ of what any one of the men got; what would fall to each?

First, $3\times3+1=\frac{10}{3}$) 478 19 6

47 17 $11\frac{1}{3}$ to the boy, for the old numerator was 1.

143 13 $10\frac{1}{3}$ to each man for the
143 13 $10\frac{1}{3}$ denominator is 3.
143 13 $10\frac{1}{3}$

478 19 6 as before.

Obſ 2. The reaſon of diviſion of fractions in general will be pretty obvious, if we conſider, that, were the diviſor and dividend reduced to one common denominator, the dividend would contain the diviſor as oft as its numerator did that of the diviſor; for, having one denominator, they are in the ſame ſtate with reſpect to one another, as whole numbers. Now, though no mention is made in the rule of a common denominator, yet the operation is manifeſtly the ſame, as that by which fractions are reduced to a common denominator. Hence we have this general conſequence, that if any two numbers be divided the one by the other, the quotient of the one by the other is the reciprocal of the quotient of that one by the other.—The method in obſervation 1. for dividing by mixed numbers in applicate caſes, is ſo plain, that it needs no demonſtration. For ſince all the parts are equal to the whole, the diviſor, I mean the numerator by which we divided, expreſſeth all the parts contained in it when a mixed number, of which the quotient repreſents ſo many as the dividend containeth, conſidered as a mixed number; the quotient therefore, when multiplied by the numerator

merator of the fractional part of the divisor, in its first state, must undoubtedly give the quotient due to that fraction; and when multiplied by the denominator, must give the quotient due to unity; the sum of all the units, and the fractional part being for proof always equal to the dividend.

Application of vulgar fractions to questions.

1. A merchant had bonds for L. 774 : 13 : $4\frac{1}{3}$, bills amounting to L. 299 : 19 : $7\frac{5}{6}$, goods valued at L. 785 : 15 : $5\frac{4}{5}$, and open accounts for L. 570 : 19 : $6\frac{3}{4}$; his debts amounted to L. 999 : 19 : $9\frac{5}{8}$; how much was he worth?

First, L.	774	13	$4\frac{1}{3}=\frac{4}{6}$	
	299	19	$7\frac{5}{6}=\frac{5}{6}$	
	785	15	$5\frac{4}{5}=\frac{16}{20}$	
	570	19	$6\frac{3}{4}=\frac{15}{20}$	
From	2331	8	0	$\frac{43}{60}$
Take	999	19	9	$\frac{5}{8}$
Nett stock,	1331	8	3	$\frac{11}{120}$

$\frac{5}{6}+\frac{2}{6}=1\frac{1}{6}=1\frac{10}{60}$.

$\frac{16}{20}+\frac{15}{20}=1\frac{11}{20}=1\frac{33}{60}$.

Therefore I carry 2, and note $\frac{43}{60}$ for the fraction.

To one versant in additions of this kind, the summation of such fractions as can be brought to one assigned denominator, is as easy as any other.

2. What will $17\frac{3}{4}$ yards of cloths come to at 15 s. 8 d. *per* yard.

First, $17\frac{3}{4}=\frac{71}{4}$, and 15 s. 8 d. $=\frac{138}{240}$. Then, $\frac{71}{4}\times\frac{138}{240}=\frac{13348}{960}=L.\ 13 : 18 : 1$.

3. Bought $17\frac{3}{4}$ yards of cloth for L. 13 : 18 : 1, what did it cost *per* yard?

First, $17\frac{3}{4}=\frac{71}{4}$, and L. 13 : 18 : 1 $=\frac{13348}{960}$. But, $\frac{4}{1})\frac{13348}{960}(\frac{53392}{68160}=15$ s. 8 d.

4. What is the solid content of a bale 5 feet 6 inches long, 4 feet 5 inches broad, and 3 feet 3 inches thick.

	f.	*i.*	
First,	5	$6=\frac{11}{2}$	least terms.
	4	$5=\frac{53}{12}$	
	3	$3=\frac{13}{4}$	least terms.

Then $\frac{11\times53\times13}{2\times12\times4}=\frac{7579}{96}=77\ 10\frac{7}{8}$ (*f.* *i.*)

5. What

5. What is the tunnage of a bale 77 feet $10\frac{7}{8}$ inches solid, at 40 *per* tun?

$$\begin{array}{l} \quad\;\; f. \quad i. \\ \frac{1}{40})77 \quad 10\frac{7}{8}=\frac{7579}{96} \; (-\frac{7579}{3840}=1\frac{3739}{3840}. \end{array}$$

6. Divide L. 578, 19 s. among A, B, C, and D; let A, B, and C have equal shares, and each $\frac{1}{3}$ more than D.

	L.	s.	d.	
$3\frac{1}{4}=\frac{15}{4}$)	578	19	0	
	38	11	$11\frac{1}{5}$	
			3	
	115	15	$9\frac{3}{5}$	to D.
	154	7	$8\frac{4}{5}$	to A.
	154	7	$8\frac{4}{5}$	to B.
	154	7	$8\frac{4}{5}$	to C.
	578	19	0	Proof.

II. OF DECIMAL FRACTIONS.

INTRODUCTION.

IN decimal fractions, an unit is supposed to be divided into 10 equal parts, each of these into 10 other equal parts, and each of these into 10 other equal parts, if necessary, and so on *ad infinitum*.

A decimal fraction is distinguished from an integer by a comma or point prefixed to it, whose denominator, though seldom or never expressed, is easily known by the distance of the first figure to the right hand, from the separating point, counted as 1, at the same distance in the numeration-table, from the unit's place. Hence .5 is expressed $\frac{5}{10}$, .75 as $\frac{75}{100}$, .05 as $\frac{5}{100}$, .005 as $\frac{5}{1000}$, &c. Hence it will be obvious, that, in a series of decimal parts, the decrease will be in proportion as the increase in a series of whole numbers, and

and that, in consequence, ciphers immediately after the point diminish the value of the figures succeeding them, in the same proportion, as the figures considered as integers would be increased by the same number of ciphers annexed.

CHAP. I.

REDUCTION OF DECIMALS.

Prob. 1. To reduce a vulgar fraction to a decimal.

Divide the numerator by the denominator; and as ciphers must be annexed to the numerator before the divison, the quotient must consist of as many places as the numerator had ciphers annexed to it, which will be the decimal required.

EXAMPLES.

(1.) (2.)

Reduce $\frac{4}{5}$ to a decimal. 5) $\frac{40}{8}$. Red. $\frac{3}{8}$ to a decimal. 8) $.\frac{3000}{375}$.

(3.)

Reduce $\frac{1}{20}$ to a decimal. 20) $.\frac{100}{05}$.

(4.)

Reduce $\frac{1}{80}$ to a decimal. 80) $.\frac{100}{0125}$.

Note, It will often happen, that, in the division, there will continually be a remainder, and the quotient repeat the same figure, or figures, *ad infinitum*; in which case, it will be unnecessary to carry on the division farther, when you have once got the repetend, which may be single, repeating always the same figure; or compound, always repeating or circulating the same figures. A single repetend may be marked or distinguished with a point above it, and compounds with a point above the first and last figures of the circulation.

EXAMPLES of SINGLE REPETENDS.

(1.)

Reduce $\frac{1}{3}$ to a decimal. 3) 10

$.\dot{3}333$ *ad infinitum.*

(2.)

Reduce $\frac{5}{6}$ to a decimal. 6) 50

$.8\dot{3}3333$ *ad infinitum.*

(3.)

(3.)

Reduce $\frac{7}{12}$ to a decimal. $12)\ 70$

$.58\dot{3}333$, &c.

(4.)

Reduce $\frac{5}{36}$ to a decimal. $36)\ 50$

$.1\dot{3}8\dot{8}$, &c.

EXAMPLES OF COMPOUND REPETENDS.

(1.)

Reduce $\frac{2}{11}$ to a decimal. $11)\ 20$

$.\dot{1}8\dot{1}8\dot{1}8$ *ad infinitum.*

(2.)

Reduce $\frac{5}{27}$ to a decimal. $27)\ 50$

$.\dot{1}8\dot{5}1\dot{8}5$, *etc.*

OBSERVATION.

The reaſon of this reduction is manifeſt: for, to add ciphers to the numerator, is in effect the very ſame thing as to multiply by 10, 100, 1000, &c.; conſequently the quotient will be ſo many 10's, 100's, 1000's, &c. as the places contained in it repreſent; the numerator and denominator being increaſed in the ſame proportion: hence, if the quotient is found without a remainder, it will be equal to the vulgar fraction, from which it was taken; and if it terminated in any repeating figure or figures, it will be ſhort of the fraction from which it was taken, by a fraction of which the remainder is the numerator, and the diviſor the denominator, in the laſt place of the qotient; that is, the remainder 1, in the firſt example of ſingle repetends, $= \frac{1}{9}$ of $\frac{1}{10000}$, and the remainder 2, in the ſecond example, $= \frac{2}{6}$ of $\frac{1}{1000000}$. If therefore, in any decimal reduction, the diviſion is carried on to 4 or 5 places, the remainder will be too minute to cauſe any ſenſible errour in calculations of buſineſs; though, at the ſame time, for the ſatisfaction of the curious, particular rules are given here for the management of circulating decimals.

Prob. 2. To reduce any of the known parts of an integer to a decimal.

This can be done by reducing the given parts to their equivalent vulgar fraction, and thence to a decimal, as above; but much more expeditiously by the following

RULE.

Annex ciphers to the given number of the loweſt denomination, and divide it by ſuch a number of that, as is equal to an unit of the next ſuperiour; to that quotient prefix the given number of units of the next ſuperiour, and divide by as many of that as will make an unit of the next ſuperiour; proceed in the ſame manner throughout the whole, and the laſt quotient is the decimal required.

EXAMPLES.

(1.)

Reduce 7s. 6d. to a decimal.

12)60

2)75

·375

(2.)

Reduce 4s. 6½d. to a decimal.

2)10

12)65

2)45416

.227083

Note 1. The reaſon of this manner of reduction is the ſame with the foregoing, as it is only dividing by the component parts of the denominator of a vulgar fraction equivalent to the given parts.

2. In reducing to decimals, it is unneceſſary to mind any ciphers on the right of the diviſor, as ciphers muſt be annexed to the remainders to bring out the quotient.

3. When in any diviſion the quotient is repeated, the next diviſion is carried on, not by ciphers, but by that repetend as in the ſecond example, and that quotient will always terminate in a repetend.

By the laſt rule, it will likewiſe be found that

s. d. *L.* *oz. dwt. gr.* *lb.*
10 $8\frac{1}{3}$ = .53472 ; that 11 18 20 Troy = .9951388 ; that
in. *feet* *c. q. lb.* *tuns.*
$4\frac{1}{6}$ = .34375, and that 19 3 14 = .99375, *&c.*

OBSERVATION.

After this manner are all decimal tables conſtructed, and they who think ſuch tables contribute any thing to diſpatch, may eaſily conſtruct them. But I cannot help thinking that any decimal parts may be found as quickly, as they can be picked out of a table, if not more ſo, by one much verſant in figuring; and with this further advantage, that, by calculating them upon all occaſions, one gains a certain practice which renders figuring eaſy and familiar, at the ſame time that he avoids the meanneſs of ſeeing with the eyes of others.

Prob. 3. To value decimals in the known parts of the integer.

Caſe 1. If the decimal was finite, multiply by as many of the next inferiour denomination as make one of the integer, and point off a number of places from the right of the product equal to thoſe in the given decimal; which will be a new decimal, to be multiplied by as many of the next inferiour denomination, as made one of the former; proceed thus till the decimal places become ciphers, or no denomination be left for a multiplier, and the figures to the left hand of the point give the value required.

EXAMPLES.

(1.) Value .375 *l.*

	s.	*d.*
375 =	7	6
20		
7.500		
12		
6.000		

(2.) Value .99375 tuns.

cwt.	*q.*	*lb.*
.99375 = 19	3	14
20		
19.87500		
4		
3.50000		
28		
14.00000		

Note, This is only the converſe of the laſt problem.

Caſe

Caſe 2. If the given decimal terminate in a repetend, carry 1 for every 9 in the product of the firſt figure of the multiplication.

EXAMPLES.

L.	*s.*	*d.*		*cwt.*	*q.*	*lb.*	lb. *Troy,*	*oz.*
.833=16		8	.666	tun=13	1	$9\frac{1}{7}$	.833 =	10
20			20				12	
16.660			13.33				10.00	
12			4					
8.00			1.33					
			28					
			9.33					

Note, In multiplying, the ciphers to the right need not be noted, but they muſt be remembered in pointing the product.

OBSERVATIONS.

1. The reaſon of carrying at 9 in multiplying repetends, will be pretty obvious, if we conſider, that a ſeries of 9's infinitely continued is equal to one in the left hand place; for it is evident that .9, or $\frac{9}{10}$, is only $\frac{1}{10}$ ſhort of 1; that .99, or $\frac{99}{100}$, wants $\frac{1}{100}$ of 1, and that .999, or $\frac{999}{1000}$, is only $\frac{1}{1000}$ of 1; ſo if the ſeries was carried on to infinity, the difference between that ſeries of nines and an unit would be equal to unity divided by infinity, which would quote nothing.

2. The firſt three places in decimals, will give the value exact enough in buſineſs; and as, in mercantile calculations, the value of the decimal of a pound Sterling is more generally wanted than any other, it may be found by inſpection thus. Double the figure next to the point, make ſhillings; if the next figure be 5, or above, add one to the ſhillings; the figure in the ſecond place, if below 5, or the ſurplus above 5, added to the third figure, make farthings; but, if their ſum be 25, or under, 25, one muſt be taken off, to make them farthings; and if their ſum be 26, or above, two muſt be taken off.

As the laſt part of this rule differs from the rules commonly given, it will perhaps be neceſſary to give ſome illuſtration of it.

The difference between a pound in thouſand parts, and a

pound in farthings, is 40: conſequently, as 1000 is to 40, ſo is any other number of decimal parts to what muſt be taken off to make them farthings; but 1000:40::500:20, ſo is 250 to 10, ſo is 25 to 1; by which it is plain that one taken from 25 1000 parts, make them 24 farthings exactly.

As the rules commonly given for finding the value by inſpection, give an anſwer frequently not preciſely the ſame with the other rule of multiplying by 20, 12, &c. and dividing by 1000, it ſeems neceſſary to ſhow that both rules give the ſame anſwer preciſely as the margin.

.507	.776
20	20
10.140	15.520
12	12
1.68	6.24
4	4
2.72	0.96

In the firſt example, there is ſeven thouſand parts, from which I take one, conform to the rule, and there remains 6 farthings, or 1 penny 2 farthings; and to find the .72 that is over, I ſay, as 25 to 1, ſo 7 to .28, which muſt be taken from the 7, as in the margin.

from	7
	.28
	6.72

In the ſecond example there is 26 over the ſhillings, from which take 2, conform to the rule, and there remains 24 farthings, or 6 pence; and to find the 96, I ſay, as 25 to one, ſo is 26 to 1.04, which muſt be ſubtracted from the 26.

	26
	1.04
	24.96

CHAP. II. ADDITION OF DECIMALS.

Caſe 1. HAVING placed the numbers to be added, whether pure decimals or mixed numbers, ſucceſſively below one another, in ſuch a manner as the ſeveral points may be in one column, tenths under tenths, hundreds under hundreds, &c.; if the given decimals are finite, add them as integers, and mark the ſeparating point in the ſum directly under the points of the given decimals, or point off as many for decimals as were in any of the given numbers which had moſt places.

EXAMPLES.

75.436	$59\frac{1}{4} = 59.25$
47.324	$67\frac{1}{2} = 67.5$
3.21	$48\frac{3}{4} = 48.75$
6.7547	$8\frac{1}{8} = 8.125$
.307	$9\frac{1}{20} = 9.05$
.005	
133.0367	$192\frac{27}{40} = 192.675$

Caſe

Case 2. When all, or any of the decimals, repeat a single digit, make the repetends conterminous, and add 1 to the sum of the first, or right hand column, for every nine that is contained in it.

EXAMPLES.

$475\frac{2}{3}$	=	$475.\dot{6}\dot{6}\dot{6}$	L. 59	7	$7\frac{1}{2}$	= L. $59.\dot{3}8\dot{2}2\dot{9}1\dot{6}$
$397\frac{1}{6}$	=	$397.1\dot{6}\dot{6}$	57	17	5	= $57.\dot{8}7\dot{0}8\dot{3}34$
$475\frac{5}{6}$	=	$475.\dot{8}\dot{3}\dot{3}$	57	13	4	= $57.\dot{6}\dot{6}\dot{6}\dot{6}\dot{6}\dot{6}$
$99\frac{1}{9}$	=	$99.\dot{1}\dot{1}\dot{1}\dot{1}$	25	6	8	= $25.\dot{3}\dot{3}\dot{3}\dot{3}\dot{3}\dot{3}\dot{3}$
$8\frac{5}{9}$	=	$8.\dot{5}\dot{5}\dot{5}\dot{5}$	45	13	4	= $45.\dot{6}\dot{6}\dot{6}\dot{6}\dot{6}\dot{6}\dot{6}$
$1456\frac{1}{3}$	=	1456.3	245	18	$4\frac{3}{4}$	= $245.\dot{9}1\dot{9}7\dot{9}1\dot{6}$

OBSERVATION.

The finite value of a pure circulate is a fraction whose numerator is the repetend, and denominator a number of as many places of nines, with a number of ciphers on the right, equal to the places betwixt the point and repetend. Hence, where the conterminous repetends of several circulates are added, their sum is a numerator to the common denominator; and if one for every nine in the sum is added thereto, it is reduced to the finite expression.

Case 3. If the decimals are compound repetends, from the place where all the repetends begin together, continue each decimal to a number of places, equal to the least common multiple of those several numbers, which represent the places of figures in the said repetends; then add, and to the last place add as many units as there are tens in the place, where the repetends all begin together, and the figures in these two places are the first and last of the repetend.

EXAMPLES.

$175.\dot{3}7\dot{2}\dot{4}$	$14.\dot{4}7\dot{2}9\dot{5}\dot{6}$	$121.\dot{4}7\dot{2}\dot{3}\dot{7}$
$84.\dot{5}\dot{6}\dot{3}\dot{4}$	$12.\dot{3}0\dot{7}\dot{2}\dot{4}\dot{3}$	$80.\dot{2}7\dot{5}\dot{5}\dot{3}$
$126.\dot{4}\dot{5}\dot{2}\dot{6}$	$9.\dot{0}2\dot{0}\dot{7}\dot{6}\dot{3}$	$64.\dot{9}0\dot{8}\dot{3}\dot{4}$
$79.\dot{3}\dot{2}\dot{7}\dot{9}$	$11.\dot{9}1\dot{2}\dot{3}\dot{7}\dot{5}$	$80.\dot{0}7\dot{4}\dot{4}\dot{4}$
$105.\dot{7}1\dot{0}\dot{5}$	$8.\dot{4}\dot{5}\dot{7}\dot{8}\dot{1}\dot{3}$	$9.\dot{8}\dot{3}\dot{3}\dot{3}\dot{3}$
$571.\dot{4}2\dot{7}\dot{0}$	$56.\dot{1}7\dot{1}\dot{1}\dot{5}\dot{2}$	$356.\dot{5}\dot{6}\dot{4}\dot{0}\dot{5}$

OBSER-

OBSERVATION.

Any repetend whatever is to the ſame number complete, as 10 to 9, if of one place; as 100 to 99, if of two places; and as 1000 to 999, if of three places, *&c.* Hence any number multiplied by 1, with as many ciphers as it contains figures, and the product thereof divided by as many nines, will give the ſame number perpetually circulating; but to add 1 for every ten contained in the ſum, is the ſame as to multiply that ſum by 10, and divide by 9.

CHAP. III.

SUBTRACTION OF DECIMALS.

Caſe 1. PLACE the numbers homogeneous under homogeneous, ſo as point may be under point; then, when the decimals are finite, ſubtract as in integers, and let the point in the remainder ſtand directly under thoſe of the factors.

EXAMPLES.

From *L.*	74	19	6 = 74.975	*L.*	171	13	6 = 171.675
Take	18	11	9 = 18.5875		97	18	9 = 97.9375
	56	7	9 = 56.3875		73	14	9 = 73.7375

Caſe 2. If a ſingle digit is repeated, borrow 9 in the firſt repeating place when neceſſary.

EXAMPLES.

From *L.*	7849	6	8 = 7849.$\dot{3}\dot{3}$	*L.*	17	11	7 = 17.57$\dot{9}\dot{1}\dot{6}$
Take	6979	13	4 = 6979.$\dot{6}\dot{6}$		14	16	8 = 14.8$\dot{3}\dot{3}\dot{3}\dot{3}$
	869	13	4 = 869.$\dot{6}\dot{6}$		2	14	11 = 2.74$\dot{5}\dot{8}\dot{3}$

Caſe 3. If the decimals be compound repetends, order them as in addition of compound repetends; and if it is neceſſary to borrow one, where both repetends begin together, add one to the right-hand place of the ſubtrahend, and that figure

figure in the remainder, where both repetends begin together, will be the firſt, and the right-hand figure the laſt of the repetend.

EXAMPLES.

47.4178178	47.8540060	153.92749
15.5656565	40 9259259	142.85353
31.8521612	6.9280801	11.07395

CHAP. IV.

MULTIPLICATION of DECIMALS.

Caſe 1. WHEN the decimals are finite, find the product as in integers, from which point off as many for places as were in both factors; if the whole product doth not count ſo far, ſupply that defect by prefixing ciphers.

EXAMPLES.

368.5	672.5	.246
2.75	.365	.125
18425	33625	1230
25795	40350	492
7370	20175	246
10.13375	245.4625	.030750

OBSERVATION.

If we conceive the two given numbers as fractions, it will be plain that the numerators and denominators are multiplied together reſpectively, ſince as many places are taken from the product, as there are in the denominators of both factors; which likewiſe accounts for prefixing ciphers, when there are otherwiſe not ſo many places in the product as were in both factors.

CON-

CONTRACTIONS.

All the contractions in the firſt part, which regard multiplication, may be applied here, but the following ſeem peculiarly adapted to multiplication of decimals.

1. To multiply by 10, 100, 1000, &c. remove the decimal point ſo many ſteps further to the right, as there are ciphers in the multiplier.

As, 47.565×100=4756.5, and .45×1000=450, &c.

2. When the places of decimals run far in both factors, the work may be contracted to as few places of decimals as may be thought ſufficient for the purpoſe, by the following rule.

Set the units place in the multiplier directly under that figure of the decimal part in the multiplicand, whoſe place you would preſerve in the product; invert all the other figures of the multiplier, and, in multiplying, begin with the figure of the multiplicand, which ſtands over the figure wherewith you are then multiplying, and ſet down the firſt figure of every particular product directly under each other, remembering at the ſame time to add the increaſe which would ariſe from the multiplication of the two next right-hand figures of the multiplicand, to the firſt figure of every product; that is, if the product of the next right-hand figure, with as many units added to it as there are tens in the product of the ſecond right-hand figure, be any number betwixt 5 and 15, carry 1: if 15, or any number below 25, carry 2, and ſo in proportion.

EXAMPLES.

Multiply 54.321711 into 3.12321, and preſerve 4 decimal places in the product.

54321711
12321.3

543217×3 = 1629651
54321×1+1 = 54322
5432×2 = 10864
543×3+1 = 1630
54×2+1 = 109
5×1 = 5

1696581

Multiply 231.3121 into 21.32, and ſave 3 decimal places.

231.3121
23.12

4626242
231312
69394
4626

4931.574

Case 2. If the multiplicand terminate in a single repetend, and the multiplier is only a single digit, carry at 9 in the first figure of the multiplication on the right hand.

EXAMPLES.

10.7016	9.305	476.05	74.86
5	7	.08	.6
53.5083	65.138	38.0844	44.920

3. If the multiplier consists of several digits, or figures, make the products conterminous before addition.

EXAMPLES.

748.65	158.83
.634	123
299462	47650
2245966	1906000
44919333	19536.50
474.64762	

Case 3. If the multiplier be a repetend, multiply the product found, as before, by 10, and divide that product by 9, which will quote the true product, if the division is continued, till the quotient terminate in a single or compound repetend.

EXAMPLES.

724.35	251.43	48.754
5.04	8.74	2.13
9)289.740	9)100.572	9)14.6263
32.193	11.1746	1.625148
3621.75	176001	4875444
	201144	97508888
Product 3653.943	Product 2198.6156	104.009481

Case 4. If the multiplicand be a compound repetend, and the multiplier only a single digit, to the product of the first figure on the right hand add as many units as there are tens in the product of the left-hand place of the repetend.

EXAMPLES.

582.347	5924.378
8	·03
4658.778	177.73135

Case 5. If there are no repetends in the multiplicand, and the multiplier be a compound repetend, add the product found, as in finite decimals, to itself in this manner. Set the first left-hand figure so many places forward, as exceeds the number of places in the repetend by one, and the rest of the figures in order after it, and proceed thus till the highest figure of the product stand directly below, or be removed beyond the lowest figure in the first position. Then, beginning with the lowest figure of the product in its first position, add it with all the figures that are below it, and do the same by the rest in their order; then point off as many places for a repetend as the multiplier consists of.

EXAMPLES.

235.01	42710.36
3.26	.20403
141006	12813108
47002	17084144
70503	8542072
766.1326	8714.1947508
7661326	87141947, &c.
7661, &c.	871
766.8994	8714.2818938

All

All theſe caſes of circulating decimals might be effected as intelligibly, though not ſo quickly, by managing them as vulgar fractions.

CHAP. V.

DIVISION OF DECIMALS.

Caſe 1. WHEN the decimals are finite, the quotient is found, as in integers, and in all caſes pointed or valued, by the following rules.

1. If the places in the diviſor and dividend are equal, the quotient is integral.

2. If the diviſor hath moſt places, annex ciphers to the dividend, to make them equal, and the quotient will ſtill be integral.

3. If the dividend hath moſt places, point off places for the exceſs in the quotient.

4. If the whole quotient is not equal to the exceſs, prefix ciphers for the defect.

Note, If, after the quotient is qualified, there be a remainder, the diviſion may be continued at pleaſure.

EXAMPLES.

(1.)

24.35)78345.15(3217
7305
5295
4870
4251
2435
18165
17045
(1120)

(2.)

.4725)113.4
.4725)113.4000(240
9450
18900
18900
....0

(3.)

```
2.87)67.05627(23.364
     574
     ---
     965
     861
     ---
     1046
      861
     ----
     1852
     1722
     ----
     1307
     1148
     ----
     (159)
```

(4.)

```
.543).0020091(.0037
      1629
      ----
      3801
      3801
      ----
       (0)
```

ILLUSTRATION.

In the firſt example, the places in each factor are two, and the quotient is integral.

In the ſecond example, becauſe the diviſor conſiſted of four places, and the dividend but of one, three ciphers were annexed to the dividend, which made the places in both equal, and the quotient was accordingly integral.

In the third example, becauſe there were five places in the dividend, and but two in the diviſor, the exceſs, 3, was pointed off for decimals.

In the fourth example, as there were ſeven places in the dividend, and three in the diviſor, the quotient required four places of decimals; and as there were but two places in the quotient, two ciphers were prefixed to make up the deficiency.

OBSERVATION.

The rationale of valuing or qualifying the quotient will appear, if we conſider, that the product of the quotient and diviſor is equal to the dividend, and conſequently the places of the diviſor and quotient, counted together, will always be equal to the dividend; or, which is the ſame thing, the number of places in the quotient muſt be equal to the difference of the places in the diviſor and dividend.

CONTRACTIONS.

1. In dividing by 10, 100, 1000, *&c.* the quotient is found

found by removing the decimal point in the dividend ſo many ſteps towards the left hand, as there were ciphers in the diviſor. Hence,

$$\frac{34.5}{10} = 3.45, \text{ and } \frac{34.5}{100} = .345.$$

2. The work of diviſion may be contracted in the ſame manner as multiplication, by the following

RULE.

Having conſidered in what place the firſt figure of the quotient ought to ſtand, and ſo found its value, or denomination, take as many of the left-hand figures as you intend to have figures in the quotient, for the firſt diviſor, and then take as many figures of the dividend as will anſwer them; in dividing, omit, or point off one figure at each operation, at the ſame time judging as exactly as poſſible what would be the increaſe, ariſing from the figure, or figures, ſo omitted.

EXAMPLES.

384,672158)14169.20662385 10(36.8345
11540 16474

26290 4188.
23080 3295.

3210 0893..
3077 3772..

132 7121...
115 4016...

17 3105....
15 3869....

1 9236.....
1 9234.....

9.365407)87.076326(9.297655
84 288663

2 787663
1 873081

914582
842886

71696
65558

6138
5619

519
468

51
47

(4)

All

All the other contractions propoſed in the diviſion of integers may be very properly applied here.

Caſe 2. When the dividend contains a ſingle repetend, and the diviſor is either a ſingle terminate digit, or any number of terminate digits, the quotient will either repeat a ſingle digit or compound repetend, commencing generally where the repetend is firſt taken down.

EXAMPLES.

8)79.26	6)3076.1...	7)51.2
9.9083	512.6851	7.317460

2. When the diviſor is only a ſingle repetend, and the dividend either a terminate number, or contains a repetend, multiply the dividend by 9, and point off the ſame number of integral places, which were firſt given, the product thus qualified will be a new dividend.

Exam. 378.45 by 6. Or thus, 572.4 by .8
9 57.24 ſubtract $\frac{1}{10}$

.6)3405 .8)515.16
567.675 643.95

3. If the diviſor hath terminate numbers joined to the repetend, ſubtract the terminate part of the diviſor from the whole diviſor,—prepare the dividend as before, and work by the new factors.

Exam.

Exam.

```
48.6̇ ) 8567.28
  48   ) 856.728
-----  ) -------
4.38   ) 7710.552(1760.4
         438
         ----
         3330
         3066
         ----
          2645
          2628
          ----
           1752
           1752
           ----
```

```
3.3̇ ] 728.5
  3   ] 72.85
----  ] -----
3.0   ] 655.65
        -----
        2185.5
```

4. When both factors, or the divisor only, consists of compound repetends, set the divisor and dividend under themselves, so many places forward, as there are places in the repetend of the divisor; subtract them, and the remainders will be respectively a new divisor and dividend.

EXAMPLES.

```
11̇1.98̇ ) 243.3̇06̇
   11   )    243
-------  ) -------
111.87   ) 243.063(2.17̈2̈
           223 74
           ------
            19 323
            11 187
            ------
             8 1360"
             7 8309
             ------
              30510
              22374
              -----
              8136"
```

```
587̇64̇5̇ ) 41135̇1.9̇
   58.7  )    411.3
-------  ) -------
587058.  ) 410940.6(7
           410940 6
           --------
              (0)
```

APPLI-

APPLICATE QUESTIONS in Decimal Fractions.

1. What is the decimal difference betwixt L. 1 and 13 s. 4 d.?

s.	d.	
		1.000
13	4	= 0.666
		.333 Answer.

2. What is the square content of a room, 15 feet 6 inches by 14 feet 9 inches?

$\frac{1}{2})14.75$

$15\frac{1}{2}$

221.25

7.375

f.	i.
228.625 = 228	$7\frac{1}{2}$

3. What is the solid content of a box 5 feet 4 inches long, 4 feet 10 inches broad, and 3 feet 8 inches thick

4.8333

$5\frac{1}{3}$

24.1666

1.6111

25.7777

$5\frac{2}{3}$

77.3333

8.5925

8.5925

f.	i.
94.5185 = 94	6

4. What

4. What is the tunnage of a bale 9 feet 9 inches long, 7 feet 3 inches broad, and 5 feet 6 inches thick?

9.75
7¼

68.25
2.4375

70.6875
5.5
---
353 4375
3534 375

4.0)388.78125 ſolid content.

9.71953125 tunnage.

5. A piece of cloth, conſiſting of 25½ yards, is valued at £ 23 : 17 : 5½; how muſt one yard be valued at that rate?

25.5) 23.872916
5.1)

4.774583

.9361927 = 18 s 8½ d.

6. What coſt 22 cwt. 3 qrs. of ſugar, at L 3 : 17 : 6 per cwt.?

3.875
22¼

7750
7750

85.25 = 22 cwt
1.9375 = ½
.96875 = ¼

88.15625 = 22¼ = L 88 : 3 : 1½

7. Divide L. 875 : 14 : 6, among A, B, and C, whereof let A have $\frac{3}{4}$, B $\frac{1}{8}$, and C

$\frac{3}{4}$ = .75
$\frac{1}{8}$ = .375
$\frac{1}{5}$ = .6

5) 1.725 | 875.725
.345 | 175.145
.069 | 35.029(507.6666×
345
529
483
460
414
.46 *ad infinitum.*

.75 = 380.75 = A's ſhare.
.375 = 90.375 = B's ſhare.
.6 = 304.6 = C's ſhare.
875.725 Proof.

lb. z. dwt.
8. What will 46 8 16 amount to at L. 7 : 8 : 6 *per* lb.?

40)46.73 = the weight.
7.4 = L. 7, 8 s.

18.6933
327.1333
For 6 ds. 1.1683

346.995 = L. 346 : 19 : 10$\frac{1}{2}$

Demonſtration of the laſt contraction after diviſion of integers, promiſed in this place.

The ſum of 1, 10, 100, 1000, *&c.* continued to any number of terms = 1, the firſt term, as often repeated as the number of terms to be added: Thus, 1+10=11, and 1+10+100=111; and 1+10+100+1000=1111, as is obvious from the nature of numerical notation. Therefore, if any number,

number, as N, is multiplied by a ſeries of equal figures, as fff, &c. the firſt product by f, in the place of units, will be fN, or $1fN$; the next product by f, in the place of tens, will be $10fN$, the next $100fN$, &c.; and the total product of the whole multiplication will be $111fN$, according to the number of places in the multiplier. If 1, 10, 100, 1000, is divided decimally by 9, the quotient figures will be 1111, &c. continued to the number of periods in the dividend, thus $\frac{1}{9}$=.1111, and $\frac{10}{9}$=1.1111, and $\frac{100}{9}$=11.1111, ſtill leaving 1 of a remainder, and the quotient continually repeating 1. Therefore, $\frac{fN}{9}$=.1111 fN; and, if we compare the two expreſſions, $111fN$ and $1111fN$, &c. we will find they may be made equal, by placing the decimal point after the third figure, in the laſt, thus, 111.111, &c. and then ſubtracting 111 from the decimal parts, the laſt, as well as the firſt, will be equal to the total product required. That is, $\frac{fN}{9}-.1111fN=111fN=T$, the total product.

For let the multiplicand N = 784
The multiplier f = 333

Therefore fN = 2352

$111fN=\frac{fN}{9}$ = 261.3333, &c.
$111fN$ the difference deduced from the right hand = 2613

261072=T, the total product.
Q. E. D.

Note, The figure 3 repeating equally in both on the right hand, and making no difference, is not to be ſubtracted.

THE UNIVERSAL ACCOUNTANT.

PART III.

THE ELEMENTS OF ALGEBRA.

INTRODUCTION.

ALGEBRA is the art of reckoning by ſymbols, or a ſhort and conciſe method of reaſoning on the various relations of numbers and quantities to each other, by the help of letters, or ſuch other characters, as the algebraiſt thinks moſt convenient to adopt.

By algebra are reſolved, in a method of reaſoning which is clear and connected, and founded on ſelf-evident principles, many obſcure queſtions in arithmetic and geometry, and from thence theorems deduced, which hold univerſally with reſpect to problems of the ſame nature. Hence it is called by ſome *the new analyſis*, by others *ſpecious arithmetic*, or *numerical geometry*, becauſe it is equally connected with both, and extends not only to abſtract numbers, but alſo to lines, ſurfaces. and ſolids. It is not intended in this place to conſider algebra in its full extent; what is preciſely neceſſary for conducting the arithmetician ſcientifically through the whole of mercantile computations, ſhall be reduced to a few plain and intelligible rules; by the help of which we ſhall be able to demonſtrate the reaſon of the moſt complicated operation that can occur in arithmetic, with greater perſpecuity and elegance, than from principles purely arithmetical. At the ſame time, in the courſe of this work, we will not make uſe of algebraic demonſtrations, but where we cannot otherwiſe do juſtice to the ſubject, that the reader may have an alternative, if his time ſhould not permit him to ſtudy this part of the treatiſe.

CHAP.

CHAP. I.

NOTATION of ALGEBRA.

ANY ſimple number is repreſented by a ſingle letter, and, for diſtinction's ſake, numbers that are known, and given in a queſtion, are generally expreſſed by conſonants, and numbers that are required are expreſſed by ſome of the ſmall vowels. Compound quantities are repreſented by two or more letters joined together; the ſum of two or more numbers is expreſſed by the ſign + connecting two or more letters together, as $a+b$ means a and b added together; $a+e+b$ means the ſum of a and e and b added together. The difference of two numbers is noted by the ſign —: thus $a-b$ ſignifies the difference of a and b, or what b wants of being equal to a. The product of two or more letters is expreſſed by connecting them together in the form of a word, as $ab=a\times b$; $abc=a\times b\times c$; that is, the continual product of a, b, and c. The quotient of two numbers by diviſion is expreſſed like a vulgar fraction, with one letter repreſenting the dividend above the line, and another below it repreſenting the diviſor, as $\frac{a}{b}$ ſignifies the quotient ariſing from a divided by b, or $a\div b$. The ſquare of any number or quantity is repreſented by a letter doubled, as aa, or its power noted above it thus a^2, each of which notations expreſs the ſquare of a, or a ſquare. The cube of any number or quantity is repreſented by tripling the letter, or noting its power, as aaa, or a^3 the biquadrate thus, $aaaa$, or a^4, &c. The ſquare root of any number is thus noted $\sqrt{2}$, the cube root $\sqrt{3}$, the biquadrate $\sqrt{4}$, &c.; as $\sqrt{2}\,186$ is to be underſtood the ſquare root of 186; $\sqrt{3}\,27\,c$ is to be underſtood the cube root of $27\,c$.

OBSERVATION.

The characters + and — in algebra import ſomething more than ſimple addition and ſubtraction, as in arithmetic: + is an affirmative or poſitive ſign, expreſſive of real exiſtence; and when it is put before any quantity, it is to be underſtood that that quantity is of a real and poſitive nature; whereas — is the ſign of negation, or negative exiſtence, denoting the quantity to which it is prefixed to be leſs than nothing.

Though no real body or ſubſtance can properly be ſuppoſed

ſed to be leſs than nothing, yet quantities, whereby the different degrees of qualities are eſtimated, may eaſily be conceived to paſs from an exiſtence through nothing into negation. Thus a merchant's ſtock was at firſt 1000 *l.* incumbered only with 50 *l.* of debt, then his neat ſtock was 1000—50; but in the courſe of trade he met with misfortunes, which raiſed his debts to 1000 *l.* and his ſubject when collected together amounted to no more than 1000 *l.* and in this caſe he is juſt worth nothing: unwilling, however, to give up his trade, he ſtruggles hard to preſerve his credit for another year, and then, upon examining his books, finds he was ſtill 1000 *l.* in debt, and no ſubject to pay it, and in this caſe he is 1000 *l.* worſe than he was the preceeding year, and at that time he was worth nothing, conſequently he will be at this time 1000 *l.* worſe than nothing. Wherefore, as affirmative and negative quantities are contrary in their nature, they are likewiſe contrary in their effects; a conſideration which, if properly attended to, will obviate all the difficulties that may occur in the application of theſe ſigns; for the reſult of working by affirmative quantities is, in every operation, obvious, and therefore like operations, where the quantities are negative, may be known by the rule of contraries.

Where there is no ſign prefixed to a quantity, the quantity is always underſtood to be affirmative, and if there is no numercial coefficient before it, unity muſt always be underſtood: thus $3a$ ſignifies $+3a$, and a ſignifies $+1a$; but the ſign of a negative quantity is never omitted, nor indeed the ſign of an affirmative one, excepting when ſuch an affirmative quantity is conſidered by itſelf, or happens to be the firſt in a ſeries of quantities ſucceeding one another.

CHAP. II.

ADDITION OF ALGEBRAIC QUANTITIES.

1. ADD homogeneous quantities according to their number.

EXAMPLES.

(1.) $a+a+a=3a$

(2.) $27a+3a=30a$

(3.) $4b+3b+5b=12b$

2. Heterogeneous

2. Heterogoneous or different quantities, expreſſed by different letters, are added by connecting them with the ſign +. Thus a and b and c are added $a+b+c$, &c.

3. When the quantities to be added have like ſigns, the ſame ſign is to be retained in the ſum.

EXAMPLES.

(1.)	(2.)	(3.)
$+3a-4b$	$15c+5b-4a$	$43a+56$
$+7a-5b$	$16c+3b-3a$	$37a+13$
$10a-9b$	$31c+8b-7a$	$80a+69$

In this caſe it is plain, that one affirmative increaſed by the acceſſion of another affirmative, muſt make a greater affirmative, in the ſame ſenſe that a ſtock of 1000 *l.* increaſed by a legacy of 500 *l.* would in this new ſtate be worth 1500 *l.*; and that one negative increaſed by the addition of another negative muſt make a greater negative, in the ſame ſenſe that the loſs of 1000 *l.* followed by another loſs of 500 *l.* would increaſe the loſs to 1500 *l.*

4. If the quantities to be added have contrary ſigns, the one affirmative and the other negative, the ſign of the greater quantity muſt be prefixed to their difference.

EXAMPLES.

$+86$	$+2a$	$+37d$	$+a$
-36	$-9a$	$-14d$	$-a$
$+50$	$-7a$	$+23d$	0

In this caſe it is plain, that the ſum of the quantities muſt be found by ſubtracting the leſſer coefficient from the greater and prefixing the ſign of the greater quantity; for let $+37a$ repreſent 37 *l.* which a man hath in his pocket, and $-19a$, 19 *l.* which he muſt pay out of it, he will after all have $+18a$: but reverſe the caſe, and ſuppoſe he hath only $+19a$ to pay $-37a$, he will then have $-18a$ or 18 l. ſhort of his ſum.

From theſe four caſes may be deduced one general rule for addition of algebra, *viz.* Add like ſigns, and retain the ſame ſign in the ſum; but ſubtract contrary ſigns, and keep the ſign of the greater.

EXAM-

EXAMPLES.

$4a-8b$	$4b+3c$	$3a+b$	$b-c$
$a+5b$	$2b-c$	$a+2b$	$b-2c$
$5a+b$	$6b+2c$	$4a+3b$	$2b-3c$

CHAP. III.

SUBTRACTION of ALGEBRAIC QUANTITIES.

1. HOmogeneous quantities are ſubtracted by taking the difference of their coefficients, as

$5a-3a=2a$. $76-6=70$ and $8b-b=7b$.

2. Heterogeneous quantities admit of no other ſubtraction but the ſign —, as the difference betwixt a and b would ſtand $a-b$, upon the ſuppoſition that a is the greateſt quantity.

3. If quantities have like ſigns, their difference retains the ſame ſign.

4. If a greater quantity muſt be taken from a leſſer, to the difference betwixt the quantities prefix the contrary ſign. Thus if it were required to ſubſtract $+5b$ from $+2b$, the remainder would be $-3b$. For ſuppoſe a man owes me 2 *l.* or $2b$, and I owe another man 5 *l.* or $5b$; it is plain that the difference betwixt theſe ſums is a debt upon me, for which I have nothing equivalent, and therefore I am 3 *l.* or $3b$ worſe than nothing: for had the ſums been equal, I ſhould have had nothing in reverſion, but then the firſt 3 *l.* or $3b$ I ever got ſhould have been my own; but whilſt I am 3 *l.* or $3b$ in debt, I muſt get 3 *l.* or $3b$ before I am even with the world, and therefore in every acceptation in this caſe the remainder is a negative quantity. Beſides, for a proof of ſubtraction, $+5b-3b$ being added together will be found $=+2b$.

5. When the quantities to be ſubtracted have different ſigns, add their coefficients, and to that ſum prefix the ſign of the minuend, which will expreſs the difference. From $+5a$ if it was required to ſubtract $-3a$, the remainder would be $+8a$: but if it had been required to take $+5a$ from $-3a$ the remainder would be $-8a$. Hence to ſubtract a negative is the ſame thing as to add an affirmative, and to ſubtract an affirmative

affirmative is the ſame thing as to add a negative: For in the firſt inſtance, if I am in poſſeſſion of $5a$, and indebted in $3a$, ſhould that debt be forgiven, I am certainly $3a$ better than when it ſtood againſt me; and in like manner, if I am indebted in $5a$, repreſented by $-5a$, and have only $+3a$ to pay it, ſhould theſe $3a$ be loſt or taken from me, I am certainly $3a$ worſe than I was in my former ſituation.

EXAMPLES of COMPOUND QUANTITIES.

From	$12x$	$+6a$	$-4b$	$-12c$	$-7e-5f$
Take	$2x$	$-3a$	$+4b-$	$5c$	$+6d-7e$
Rem.	$10x$	$+9a$	$-8b-$	$7c$	$-6d-5f$

$12x+6a+4b-12c-7e-5f$

If never a member of the ſubtrahend is found to be of the ſame denomination with any member of the minuend, change the ſign of every member of the ſubtrahend, and then add it to the other; as if $5c-6d$ was to be ſubtracted from $3a-4b$, the remainder would be $3a-4b-5c+6d$.

CHAP. IV.

MULTIPLICATION of ALGEBRAIC QUANTITIES.

IN multiplying quantities, it muſt be obſerved, that like ſigns, whether affirmative or negative, produce $+$, but different ſigns produce $-$.

EXAMPLES.

$+b\times+c=+bc \qquad -b\times-c=+bc \qquad -b\times+c=-bc$

OBSERVATIONS.

1. That $+b$ into $+c$ muſt produce $+bc$, is ſelf-evident: for inſtead of the letters let us take $+4$ and $+3$ for a multiplicand and multiplier, the product in this caſe muſt be $4+4+4=+12$; wherefore $+3$ into $+4$ muſt likewiſe give $+12$.

2. $-b$ into $-c=+bc$. For aſſume the ſame figures 3 and 4 with negative ſigns, then multiply -4 into 3,0 and -3 ſucceſſively, and the products will be an arithmetical progreſ-

ſion; but the two firſt products are −12 and 0, and the third product will be +12.

3. $+b$ into $-c=-bc$. For if the product were $+bc$, it would be the ſame with the product of $+b$ into $+c$, which would be abſurd. But further, ſuppoſe a man 10 *l.* in debt, and without any ſubject to pay it, his worth may be expreſſed by −10, *i. e.* 10 worſe than nothing; the double of −10 would be −20, the triple would be −30, &c. according to any multiplication whatever. Therefore $-10\times+2$ $+3$, &c. by any multiplication whatever muſt give a negative product.

EXAMPLES.

(1.)

$$\begin{array}{r} 4a+3c \\ a-b \\ \hline -4ba-3bc \\ +3ac+4aa \\ \hline 4aa+3ac-4ba-3bc \end{array}$$

(2.)

$$\begin{array}{r} a-b \\ a-b \\ \hline -ab+bb \\ aa-ab \\ \hline aa-2ab+bb \end{array}$$

(3.)

$$\begin{array}{r} a+b \\ a-b \\ \hline -ab-bb \\ +aa+ab \\ \hline +aa \quad . \quad . \quad . -bb \end{array}$$

(4.)

$$\begin{array}{r} a+b \\ a+b \\ \hline +ab+bb \\ +aa+ab \\ \hline +aa+2ab+bb \end{array}$$

(5.)

$$\begin{array}{r} 6x-7a-8b \\ 2x-3a+4b \\ \hline 12xx-14ax-16bx+21aa+24ab-32bb \\ -18ax+24bx \qquad -28ab \\ \hline 12xx-32ax+8bx+21aa-4ab-32bb \end{array}$$

A daſh over two or more quantities imports, that all thoſe quantities are to be conſidered as conſtituting one compound quantity.

OBSER-

OBSERVATION.

From this rule there may be very naturally deduced the following theorems.

1. *Exam.* $a+b$ into $a-b$ produceth $aa-bb$. Hence the ſum and difference of any two numbers being multiplied together will give the difference of their ſquares, and *vice verſa*.

For $4\times4=16$
$2\times2=4$

Diff. 2 12 the difference of the ſquares.
Sum 6

Product 12 of their ſum and difference.

2. *Exam.* 4 $a+b$ into $a+b$ produceth $aa+2ab+bb$. Hence, if a number be reſolved into any two parts whatever, the ſquare of the whole will be equal to the ſquare of each part, and the double rectangle, or product of the multiplication of thoſe parts added together. Thus, if the number 10 be reſolved into 7 and 3, 100 the ſquare of 10, the whole will be equal to $7\times7+3\times3+7\times3\times2$, which is the ſquare of each part, and double the product of the parts. *Eucl. book* 2. *prop.* 4.

3 *Exam.* 2 $a-b$ into $a-b$ produceth $aa-2ab+bb$. Hence, if from the ſum of the ſquares of any two numbers be ſubtracted the double product of thoſe two numbers, there will remain the ſquare of their difference. Thus in the numbers 7 and 3, $7\times7+3\times3=58$ and $7\times3\times2=42$ but $58-42=16=7-3\times7-3$, *i. e.* 4×4. *Eucl.* 2. 7.

CHAP. V.

DIVISION of ALGEBRAIC QUANTITIES.

1. TO divide ſimple algebraic quantities, divide the coefficient of the dividend by that of the diviſor, when poſſible, and then put down after the quotient all the quantities in the dividend that are not in the diviſor; and for the ſign to be prefixed to the quotient obſerve the rules in multiplication, ſince the quotient ought to contain a quantity, which being multiplied into the diviſor, will produce the dividend.

EXAMPLES.

(1.)
$+4b)-8bc($ $-2c$
$+4b$

$-8bc$ Proof.

(2.)
$4a)24abc($ $6bc$
$4a$

$24abc$ Proof.

(3.)
$3b)18bc($ $6c$
$3b$

$18bc$ Proof.

(4.)
$4a)12abc($ $3bc$
$4a$

$12abc$ Proof.

2. When the coefficients are incommenſurable, or the quantities heterogeneous, place the diviſor below the dividend in the manner of a vulgar fraction; as

$$\frac{b}{a} \qquad \frac{17b}{9a} \qquad \frac{5ab}{7a} \qquad \frac{9xm}{7xm}$$

CHAP VI.

ALGEBRAIC FRACTIONS.

FRactions in algebra are managed in the ſame manner as in arithmetic, in their reduction, addition, ſubtraction, multiplication, and diviſion; with this difference only, that the operations in the one are numerical, and in the other algebraical.

EXAMPLES.

1. Reduce $\frac{4ab}{6bc}$ to their loweſt terms,

Here $2b$ is a common meaſure for both numerator and denominator, and therefore when they are both divided by $2b$, the quotient will be $\frac{2a}{3c}=\frac{4ab}{6bc}$, but expreſſed in lower terms. Hence it follows, that whenever a common letter or factor is to be found in every member both of the numerator and denominator, it may be cancelled every where without affecting the value of the fraction; thus the fraction $\frac{ac+bc}{cd+ce}$, expunging c, becomes $\frac{a+b}{d+e}$; but if there be any one member wherein the factor is not concerned, it muſt not be expunged at all.

2. Reduce

2. Reduce $\frac{a}{2}$ $\frac{b}{3}$ $\frac{c}{4}$ to one common denominator.

$a\times3\times4=12a$
$b\times2\times4=8b$ } Numerators.
$c\times3\times2=6c$
$2\times3\times4=24$ Common denominator.

3. Add $\frac{2b}{3a}$ and $\frac{3b}{4a}$

$3a\times3b=9ab$
$4a\times2b=8ab$
$\frac{17ab}{12aa}=\frac{17b}{12a}$
$3a\times4a=12aa$

4. Subtract $\frac{a}{2d}$ from $\frac{4a}{5a}$

$a\times5d=5da$
$4a\times2d=8da$
$\frac{3a}{10da}=\frac{3a}{10d}$
$2d\times5d=10da$

5. Multiply $\frac{4a}{9}$ into $\frac{4ba}{7d}$

$4a\times4ba=\frac{16baa}{63a}$
$9\times7d=63a$

6. Divide $\frac{a}{4d}$ by $\frac{4b}{c}$

$\frac{c}{4b})\frac{a}{4a}(\frac{ca}{16ba}$

CHAP. VII.

INVOLUTION NUMERICAL and ALGEBRAICAL.

INvolution is the raiſing of a quantity or number to any aſſigned power, and is performed like multiplication, the multiplier always continuing the ſame. Hence, when a quantity or number is ſaid to be raiſed to a certain power, it is multiplied into itſelf as often as the power to which it is raiſed expreſſeth.

Thus when 4 is multiplied into itſelf, it becomes 16, which is the ſquare or 2d power of 4; when the ſquare 16 is multiplied into 4, it will produce 64, the cube or 3d power; and when 64 is multiplied into 4, it will produce 256, the biquadrate or 4th power; and that multiplied into 4 will produce 1024, the ſurſolid or 5th power, &c.

In like manner, $a\times a=aa$ or a^2; $a^2\times a=aaa$ or a^3; $a^3\times a=a^4$; and $a^4\times a=aaaaa$ or a^5, &c. To expreſs the power by a digit is

is no doubt the beſt method of notation, as it is ſhorteſt, and the power diſcovered by its index at once, without the trouble of numbering the repetitions, which in the other caſe is unavoidable.

Examples of roots raiſed to the 3d power.

$4a$	$5b$
$4a$	$5b$
$16a^2$ ſquare.	$25b^2$
4	$5b$
$64a^3$ cube	$125b^3$
$a+b$ a binomial root.	$a-b$ a reſidual root.
$a+b$	$a-b$
$a^2+2ba+b^2$	$a^2-2ba+b^2$
$a+b$	$a-b$
$a+3ba^2+3bba+b^3$	$a^3-3ba^2+3bba^2$

CHAP. VIII.

EVOLUTION OF ALGEBRAIC QUANTITIES.

EVolution reduces any given power back to its original quantity when poſſible. To do which it muſt be obſerved, that ſome quantities are rational and have roots; but there are others ſurd or irrational, whoſe juſt root cannot be extracted. In the firſt ſpecies of quantities, conſider what quantity involved or multiplied into itſelf as often as the index repreſents will produce a quantity equal to that given, and the quantity found in this manner will be that required. Thus, ſuppoſe it was required to extract the root of a^2, it would be $a \times a = a^2$, conſequently a is the root required. In the ſame manner a is found to be the root of a^3, for $a \times a \times a = a^3$. In the ſame manner $81d^2$ will be found to proceed from $9d$, for $9d \times 9d = 81d^2$.

Thus likewiſe will a be found to be the cube root of a^3, for $a \times a \times a = a^3$, $4a$ the cube root of $64a^3$, and a the biquadrate root of a^4.

If

If the ſquare root of $a^2+2ab+b^2$ was required, it would be found to be $a+b$; for $a+b \times a+b = a^2+2ab+b^2$. In the ſame manner will $a-b$ be found to be the ſquare root of $aa-2ab+b^2$.

In this manner likewiſe may be found the roots of higher powers, as $a^3+3ba^2+3bba+b^3$, whoſe root is $a+b$.

In ſurd or irrational quantities, the roots are ſignified or denoted by the radical ſign prefixed thus, $\sqrt{2}g$. $\sqrt{2\ 12\ B+c}$, $\sqrt{2\ a^2-G}$ is the ſquare root of thoſe quantities to which the ſign $\sqrt{2}$ is prefixed; and $\sqrt{3\ B+H}\sqrt{3\ 24S+a3}$ is the cube root of the quantities to which the ſign $\sqrt{3}$ is prefixed.

CHAP. IX.

Of SURD QUANTITIES.

1. IF the given ſurd quantities are heterogeneous, they are added by connecting them with the ſign +, and ſubtracted with the ſign —; as $\sqrt{2\ B}+\sqrt{2\ C}$ expreſſeth the ſum of theſe two ſurd quantities, $\sqrt{3G}-\sqrt{3ab}$ expreſſeth the difference of the ſurd quantities on each ſide of the negative ſign.

2. When they are homogeneous, they are added and ſubtracted according to their number; as $4\sqrt{2B}+8\sqrt{2B}=12\sqrt{2B}$, and $9\sqrt{3G}-3\sqrt{3G}=6\sqrt{3G}$, &c.

3. Surds are ſometimes multiplied and divided by the ſigns $\times$ and $\div$ connecting them, $\sqrt{2b}\times\sqrt{2c}$, or $\sqrt{2b}\div\sqrt{2c}$; and ſometimes by multiplying and dividing the quantities themſelves, when it can be done, and prefixing the radical ſign to the product or quotient, as $\sqrt{2ab}\times 2\sqrt{2\ 12b}=\sqrt{2\ 12ab^2}$; or $\sqrt{2b}\times\sqrt{2a}=\sqrt{2ab}$, and $\sqrt{2\ 12ba}\div\sqrt{2\ 4a}=\sqrt{3}3b$; and $\sqrt{2\ 18bb}\div\sqrt{7b}=\sqrt{3b}$, &c.

4. Surds are involved merely by removing the radical ſign; thus to ſquare $\sqrt{2G}$, take away the ſign $\sqrt{2}$, and there is left G= the ſquare of $\sqrt{2G}$. To cube $\sqrt{3G}$, take away the radical ſign $\sqrt{3}$, and there will remain G = to the cube of $\sqrt{3G}$; and this holds good in all caſes, whatever power is repreſented by the radical ſign.

CHAP. X.

RULES OF EQUATION.

BY equation is to be underſtood in general one expreſſion of a number or quantity made equal to another; thus, $4+6=10$, and $7-3=4$; or $9\times6=54$; or $12\div4=3$. And in the ſame manner may theſe quantities $a+b=G$, or $a-b=D$, or $ab=P$, or $\frac{a}{b}=Q$, *&c.*

There is no queſtion can occur in numbers or quantities, but ſome equation will ariſe from the very terms of the queſtion, if they are intelligibly put: for inſtance, ſuppoſe a number was required, whereof $\frac{1}{3}$ and $\frac{1}{4}$ being added, the ſum would be 18. Let this number be repreſented by a, then will $\frac{1}{3}a+\frac{1}{4}a=18$. Wherefore the equation here is $\frac{7}{12}a=18$, and from this equation the number is required. Again, let the queſtion be to find two numbers, the ſum whereof is 24, and difference 12. In this caſe, one equation will be $a+e=24$, and another $a-e=12$; and ſo there are two equations given, and two numbers required. Hence ariſes this general

RULE.

When the number of equations given in any queſtion are juſt equal to the number of quantities required, and the one equation no way inconſiſtent with the other, the queſtion is truly limited, and capable of a ſolution; but when the number of equations given are not ſo many as the numbers required, the queſtion is ambiguous, and admits of various anſwers. If the number of equations given exceed the number of quantities required, and if any one of theſe equations is found inconſiſtent with the other, the queſtion is impoſſible, and can have no rational anſwer.

Rules for reſolving ſimple equations.

1. To letter a queſtion, or to repreſent quantities by proper characters.

As this is in a great meaſure arbitrary, or matter of choice, we need only obſerve, that in general given quantities are repreſented either by conſonants or abſolute numbers, as they

lie in the queſtion; and quantities required, by ſome of the ſmall vowels, one or more as there is occaſion.

2. To ſtate a queſtion, or, in other words, to raiſe an equation.

The nature of every queſtion muſt be well conſidered; given and known quantities diſtinguiſhed from ſuch as are required; numbers are to be added, ſubtracted, multiplied, divided, or involved exactly, according to the conditions of the queſtion; and then one ſide of an equation compared with the other, which being done, the equation is truly ſtated. To make this ſtill plainer, by an example: Suppoſe it was required to find a number to which $\frac{1}{4}$ of itſelf being added, 5 ſubtracted from the ſum, the remainder multiplied by 10, and the product divided by 4, gives 25 in the quotient.

For the unknown number put a, and for the given quotient put Q. The other members, being but ſmall, may be taken abſolutely as they lie, or repreſented by letters; but in this inſtance, let them be taken abſolutely as they lie. Then by conſidering the queſtion, the following equation will occur, $a+\frac{1}{4}a-5\times 10\div 4=Q$; which is ſtating the queſtion at large. And the ſame may be abridged in the manner which the ſigns of addition, ſubtraction, multiplication, and diviſion require; thus, $a+\frac{1}{4}a=\frac{5}{4}a$, by ſubtracting 5, it becomes $\frac{5}{4}a-5$, which, multiplied into 10, it becomes $\frac{50}{4}a-50$; and this being divided by 4, it becomes $\frac{12\frac{1}{2}a-50}{4}=Q$. And thus will the equation be ſtated and properly abridged.

3. To reduce an equation.

After the queſtion hath been properly ſtated and abridged, the equation muſt be reduced, by bringing the unknown quantity a, and its coefficients, to one ſide, and the known quantities to the other: for this purpoſe, obſerve the following caſes,

Caſe 1. When $a-b=G$, reduce by addition, ſince equal quantities added to equal quantities give equal ſums; b added to both ſides gives $a=G+b$.

Caſe 2. When $a+b=G$, reduce by ſubtraction, ſince equal quantities taken from equal quantities give equal remainders; thus, by ſubtracting b, it will be $a=G-b$.

Case 3 When $\frac{a}{b}=G$, reduce by multiplication, since equal quantities multiplied by equal quantities give equal products; by multiplying both sides by b, it will be $a=Gb$.

Case 4. When $ab=G$, reduce by division, since equal quantities divided by equal quantities give equal quotients; therefore, dividing both sides by b we have $a=\frac{G}{b}$.

Case 5. When $\sqrt{a}=G$, reduce by involution; for since equal roots have equal squares, cubes, biquadrates, *&c.*; wherefore by squaring, cubing, *&c.* both sides, we will have $a=GG$, or $a=G^2$

Case 6. When $a^2=G$, reduce by evolution; for since equal quares, cubes, biquadrates, *&c.* have equal roots, by extracting the root of each, we will have $a=\sqrt{G}$.

By these six cases, founded on their respective axioms, all equations whatever may be reduced; but to set the application in a more practical point of view, let us resume the equation $\frac{12\frac{1}{4}a-50}{4}=\mathfrak{Q}$.

Since one side of the equation, where a the unknown quantity lies, must be divided by 4, in order to remove the fraction, multiply both sides by the denominator 4; and then you will have $12\frac{1}{4}a-50=4\mathfrak{Q}$; for not to divide $12\frac{1}{4}a-50$ by 4, is the same thing as to multiply $\mathfrak{Q}$ by 4.

Then seeing 50 is a known number, affected with the sign —, remove it by case 1. to the known side of the equation, and then we will have $12\frac{1}{4}a=4\mathfrak{Q}+50$; and, in this case likewise, not to subtract 50 from $12\frac{1}{4}a$, is the same thing as to add it. But still there is a fraction upon one side; wherefore multiply both sides of the equation by the denominator 2, and we will have $25a=8\mathfrak{Q}+100$. Lastly, dividing both sides by the coefficient of a, *viz.* 25, we will have $a=\frac{8\mathfrak{Q}+100}{25}$ by which means the equation is not only reduced, but resolved; for the unknown quantity a, by itself alone is found equal to such as are known, namely $8\mathfrak{Q}=200=8\times25$, for $\mathfrak{Q}$ was $=25$; then $\frac{200+100}{25}$ $\frac{300}{25}=12$, the number required, or the value of a:

CHAP.

CHAP. XI.

PROBLEMS producing SIMPLE EQUATIONS.

A Simple equation is that wherein the unknown number or quantity a is found equal to known numbers, by multiplication or diviſion only, without the extraction of roots, as in the above example; or, if $\frac{a}{4}=12$, then $a=4\times 12=48$; or if $4a=12$, then, by diviſion, $a=\frac{12}{4}=3$, and it will be the ſame in letters for $\frac{a}{b}=g$, therefore, $a=bg$; and $ab=g$, therefore $a=\frac{g}{b}$, &c.

Prob. 1. A man being aſked how many bank-notes he had in his pocket-book, made anſwer, If to what I have you add as many, $\frac{1}{2}$ as many, and $7\frac{1}{2}$ more, I would then have 130; required the number he had?

In this problem there is only one number required, for which put a, and there are two given, *viz.* 130, for which put S, and $7\frac{1}{2}$, for which put B.

Then according to the conditions of the queſtion, $a+a+\frac{1}{2}a+B=S$; which, being properly abridged, will be $2\frac{1}{2}a+B=S$.

Then remove B to the known ſide of the equation by ſubtraction and it will be $2\frac{1}{2}a=S-B$.

Take away the fraction by multiplication, and it will be $5a=2S-2B$. But by diviſion $a=\frac{2S-2B}{5}$; wherefore $2=S$ 260, from which take $2B=15$, and there will remain 245, which being divided by 5, quotes 49, the anſwer.

Prob. 2. A man ſpeaking of his money, ſaid, that with one half of his money he could buy a certain horſe, and had he 30 *l.* more, he could purchaſe three horſes of the ſame value; how many pounds had he?

Here it appears that $\frac{1}{2}a$ is the value of the horſe, and $\frac{3}{2}a$ the value of 3 ſuch horſes, which, by the queſtion, is $=a+30$. Therefore, to remove the fraction by multiplication, it will be $2a+60=3a$, and by ſubtracting $2a$ from both ſides, $60=a$, the anſwer required.

Prob 3. A gentleman being aſked how many horſes he kept, made anſwer, For want of room in my own ſtable, I muſt put 5 horſes in my neighbour's ſtable; but I am now building a ſtable twice as large, and then I can accommodate my own horſes and 5 of my neighbour's: You may find out the number of horſes I keep.

Here it is plain that $a-5$ = the number the ſtable contains, and $2a-10$ = the number a ſtable twice as large will contain, which being 5 more than the number the gentleman had, the equation will ſtand $a+5=2a-10$; then, by adding 10 to both ſides, $a+15=2a$, and by ſubtracting a, we have $15=a$ the anſwer.

Prob. 4. A man meeting ſome beggars, found, that by giving 4 *d.* to each, he would be 4 *d.* ſhort of ſerving them all, and by giving 3 d. to each, he ſhould have 4 *d.* over; required the number of beggars, and how many pence the man had in his pocket.

Here two numbers are required, which let be repreſented by a= the number of beggars, and e= the number of pence

By the queſtion it appears, that $\frac{e+4}{a}=4$, and $\frac{e-4}{a}=3$, the two given equations. By the firſt $e+4=4a$, and $e=4a-4$; but by the ſecond $e-4=3a$, and $e=3a+4$; therefore, by comparing both equations of e, it will be $4a-4=3a+4$, and $4a=3a+8$, and $a=8$, and $e=28$. Anſwer.

Prob. 5. Two perſons, *A* and *B*, were talking of their ages; ſays *A* to *B*, 7 years ago I was juſt three times as old as you were, and 7 years hence I ſhall be twice as old as you will be. I demand their preſent ages.

Let a and e repreſent the preſent ages of *A* and *B*, that is, let $a=A$ and $e=B$; then their ages 7 years ago were $a-7$ and $e-7$, and their ages 7 years hence will be $a+7$ and $e+7$; whence, and from the conditions of the problem, may be derived the two following fundamental equations:

$$a-7=e-7\times 3=3e-21, \text{ and}$$

$$a+7=e+7\times 2=2e+14$$

From the former of theſe two equations, *viz.* $a-7=3e-21$, we have $a=3e-14$; and from the ſecond equation $a+7=2e+14$, we have $a=2e+7$; therefore $3e-14=2e+7$, ſince both are equal to a; whence $e=21$, and $2e+7$, or $a=49$.

A's

A's age therefore was 49 years, and *B*'s 21: For 7 years before *A*'s age was 42 and *B*'s 14, and $42=14\times3$; but on the other hand, 7 years after *A*'s age would be 56 and *B*'s 28; but $56=28\times2$.

Prob. 6. A certain company at a tavern found, that when they came to pay their reckoning, if there had been 3 more in company to the ſame reckoning, they might have paid 1 ſhilling apiece leſs than they did; but had there been 2 fewer in company, they muſt have paid 1 ſhilling apiece more than they did: what did each pay, and how many were there in company?

Repreſent the number in company by a, and the number of ſhillings every one actually paid by e; now, if 4 perſons were to pay 5 ſhillings apiece, the whole reckoning would be 4×5: therefore if a perſons are to pay e ſhillings apiece, the whole reckoning will be ae ſhillings. This being premiſed, ſuppoſe them now to be 3 more in company, then will the number of perſons be $a+3$; and to find what every particular perſon ought to pay in this caſe, the whole reckoning ae muſt be divided by $a+3$, and the quotient will be $\frac{ae}{a+3}=$ every one's particular reckoning: but, according to the problem, every one's particular reckoning in this caſe would have been one ſhilling leſs than it actually was, *i. e.* $e-1$; therefore $\frac{ae}{a+3}=e-1$. In like manner, the ſecond condition of the problem gives us this equation, *viz.* $\frac{ae}{a-2}=e+1$. The firſt of theſe equations, *viz.* $\frac{ae}{a+3}=e-1$, being reduced, gives $a=3e-3$; and the ſecond equation, *viz.* $\frac{ae}{a-2}=e+1$, being likewiſe reduced, gives $a=2e+2$; therefore $3e-3=2e+2$ and $e=5$; wherefore $2e+2$, or $a=5\times2+2=12$.

Hence there were 12 in company, their reckoning came to $5\times12=60$ ſhillings.

Prob. 7. One lays out 2 ſhillings and 6 pence on apples and pears, buying his apples at 4 and his pears at 5 a penny, and afterwards accommodates his neighbour with half his apples and $\frac{1}{3}$ of his pears for 13 pence, which was the price he bought them at; I demand how many he bought of each ſort?

Put a for the number of apples, and e for the number of pears.

Then

Then if 4 apples cost 1 penny, a will cost $\frac{a}{4}$; and for the same reason e will cost $\frac{e}{7}$ pence, and then we will have $\frac{a}{4}+\frac{e}{7}=36$ for one fundamental equation. Again, the price of $\frac{a}{2}$ half of his apples, will be $\frac{a}{8}$, and the price of $\frac{e}{3}=\frac{1}{3}$ of his pears will be $\frac{e}{11}$; hence we will have $\frac{a}{8}+\frac{e}{11}=13$ for another fundamental equation.

Equ. 1. $5a+4e=600$
2. $15a+8e=1560$

Subtract the second equation from thrice the first, and it will be

Equ. 3. $4e=240$
4. $e=60$

Now, substitute 60 for e, that is, 240 for $4e$ in the first equation $5a+4e=600$, and we will have $5a+240=600$; whence equation 5. $a=72$: therefore the number of apples was 72, and the number of pears 60: for $\frac{72}{2}=36$ apples at the assigned price $=9d.$ and $\frac{60}{3}=20$ pears at 5 for a penny $=4d.$; but $9+4=13$.

Prob. 8. Three men had each a certain sum of money; A and B together had $16l.$; B and C together had $27l.$; A and C together had $25l.$; how much had each?

Here three numbers are required, a, e, y, and *per* question $a+e=16$, and consequently $e=16-a$; also *per* question $e+y=27$, consequently $e=27-y$. By comparing these equations of e, it will be $16-a=27-y$, and $16-a+y=27$, and $y-a=27-16=11$, and $y=11+a$. *Lastly*, *per* question $a+y=25$, and $y=25-a$. By comparing these two equations of y, it will be $=11+a=25-a$, and $11+2a=25$, $2a=14$, $a=7$, $e=9$, and $y=18$.

CHAP. XII.

OF DIRECT PROPORTION.

BY Euclid, four numbers or quantities are proportional, when the first hath the same ratio to the second, as the third hath to the fourth; or, in other words, when the first contains the second, or is contained therein, so oft as the third

third contains the fourth, or is contained therein. Thus 3 : 9 ::6 : 18, and 6 : 4 :: 12 : 8, becauſe in the firſt, 3 is as often found in 9 as 6 is found in 18; and in the ſecond, 6 contains 4 as often as 12 contains 8. From this idea of proportion it follows, *firſt*, That if four numbers are proportional, and expreſſed by theſe four letters, A:B::C:D, the quotient of the firſt divided by the ſecond, is equal to the quotient of the third divided by the fourth: and this expreſſion is univerſally true $\frac{A}{B}=\frac{C}{D}$, as may be obſerved in any rank of four proportionals whatever; thus, if 4:5::12:15, then $\frac{4}{5}=\frac{12}{15}$; if 6:2::12:4, then $\frac{6}{2}=\frac{12}{4}$, *&c.* *Secondly*, It is alſo true, that the quotient of the ſecond divided by the firſt is equal to the quotient of the fourth divided by the third, *i. e.* $\frac{B}{A}=\frac{D}{C}$, for $\frac{5}{4}=\frac{15}{12}$, and $\frac{2}{6}=\frac{4}{12}$, *&c.* *Thirdly*, When it happens in any four numbers or quantities that the quotients are equal in this manner, theſe four numbers or quantities muſt be proportional; thus $\frac{A}{B}=\frac{C}{D}$, therefore A : B :: C : D. *Fourthly*, If four numbers are proportional, the product of the extremes will be equal to the product of the means: for if A ; B :; C : D, then as before $\frac{A}{B}=\frac{C}{D}$, multiply each ſide of the equation by B, then $A=\frac{BC}{D}$; multiply each ſide by D, and then AD=BC. the product of the extremes = the product of the means. *Fifthly*, If in any four numbers the product of the extremes is equal to the product of the means, theſe four numbers are proportional: for if AD=BC, then by diviſion $A=\frac{BC}{D}$, and again by diviſion $\frac{A}{B}=\frac{C}{D}$; therefore A: B::C:D. *Sixthly*; If three numbers are proportional, the product of the extremes is equal to the ſquare of the means: for if A : B :: B : C, it will be AC=BB by the fourth; and if AC=BB then by the fifth it will be A:B::B:C.

Prob. 1. Three numbers being given, to find a fourth direct proportional. Let the number ſought be *a*, and the three given numbers B,CD. Then B : C :: D : *a*; therefore the product of the extremes will be equal to the product of the means B*a*=CD. Divide both ſides of the equation by B, and then $a=\frac{CD}{B}$, the product of the ſecond and third divided by the firſt.

Prob.

Prob. 2. Two numbers being given, to find a third proportional, put BC the two given numbers, and *a* the third proportional, then B:C::C:*a*; and as before $Ba=CC$; dividing both ſides by B we have $a=\frac{CC}{B}$, the ſquare of the ſecond divided by the firſt.

CHAP. XIII.

Alternation, Inverſion, Compoſition, and Diviſion of Proportion.

WHat Euclid demonſtrates, *book* 5. concerning proportional quantities, as far as relates to numbers and quantities that are commenſurable, may be demonſtrated algebraically from what hath been ſaid in the laſt chapter. *Firſt*, If A:B::C:D, then by alternation it will be A:C::B:D becauſe in the laſt as well as the firſt the product of the extremes is equal to the product of the means, *viz.* AD=CB. *Secondly*, It will be by inverſion D:C::B:A; for in this alſo DA=CB. *Thirdly*, It will be by compoſition D+C:C:: B+A:A; for ſince AD=CB, add AC to both, and then AD+AC=CB+AC. But the firſt of theſe is the product of D+C×A, and the ſecond is the product of B+A×C. *Fourthly*, It will alſo be by diviſion, D—C:C::B—A:A; for AD=CB, and by ſubtracting AC, it will be AD—AC=CB—AC. But the firſt is the product of D—C×A, and the ſecond is the product of B—A×C. In like manner we may demonſtrate proportion converted alternately compounded or divided, *&c.* by the ſame pinciples.

CHAP. XIV.

COMPOUND PROPORTION.

IF A:B::C:D and E:D::F:*a*, then it will be as AE: the product of the firſt two antecedents, :B the firſt conſequent; ::CF the product of the ſecond two antecedents, :*a* the ſecond conſequent. For by the firſt A:B::C:D, hence AD=BC; and by the ſecond, E:D::F:*a*, hence Ea=DF: therefore the products of thoſe equal quantities

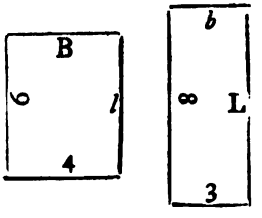
will be equal; that is, AD×Ea, or ADEa=BC×DF, or BCDF: divide both ſides by D, and then AEa=BCF; therefore AE:B::CF:a. *Q. E. D.*

If therefore five numbers are given, A:B::C, to find a, the
E F
ſixth direct proportional or anſwer required, it is plain, that a is found by multiplying the antecedents together, then multiplying the product of the ſecond two antecedents by B, the ſecond term of the proportion, and dividing by the product of the two firſt: for ſince AE:B::CF:a, it will be AEa=BCF and $a=\frac{BCF}{AE}$; and however many antecedents there may be, the operation will ſtill be the ſame, which might be eaſily demonſtrated from the ſame principles.

CHAP. XV

RECIPROCAL, or INVERSE PROPORTION.

IF two rectangles, as thoſe in the margin, are equal the one to the other, but differing in length and breadth; or, which is the ſame thing, if any two products are equal the one to the other, as 8×3=6×4, in letters Lb=lB: for, as the length of the longeſt rectangle 8, or L, is to the breadth of the ſhorteſt, 4, or b; ſo reciprocally is the length of the ſhorteſt 6, or l, to the breadth of the longeſt, 3, or b: Hence as L:B::l:B. Here he firſt antecedent, and the laſt conſequent, are found in one and the ſame rectangle, or product, as are the firſt conſequent and laſt antecedent found in the other. If this proportion is inverted in ſuch a manner, as to take the firſt antecedent and firſt conſequent in one number, and ſecond antecedent and ſecond conſequent in another, inſtead of direct proportion, we will then have inverſe proportion, and no longer will the product of the extremes be equal to that of the means; but, inſtead thereof, the product of the firſt and ſecond terms ſhall be equal to that of the third and fourth. Thus directly L:B::l:b, but inverſely, L:b::l:B. Therefore, to find a



fourth inverſe proportional, we muſt always multiply the two firſt terms, and divide their product by the laſt. For as $L:b::l:B$, and $Lb=lB$, and $\frac{Lb}{l}=B$. Hence it is obvious, that the inverſe rule of proportion may be made direct, or the direct rule of proportion may be made inverſe, only by changing the order of the terms.

CHAP. XVI.

To turn Equations into Analogies; or The application of Algebra to the varieties in Proportion.

Prob. 1. TWO merchants, A and B, had each a certain ſtock; A's ſtock was to B's as 2 to 3. By trading A gained 3000 *l.* and B 3500 *l.* and then A's ſtock was to B's as 4 to 5. Required their reſpective ſtocks at firſt?

For 3 put r, and for 4 put R; let A's gain be repreſented by $g=3000$, and B's by $G=3500$, 4 in the ſecond proportion by q, and 5 by Q, and let the numbers required be a and e.

Firſt then $a:e::r:R$, *per* queſtion, and by multiplying extremes and means, $aR=er$, and dividing both by r; $e=\frac{aR}{r}$, to both add their reſpective gain, and we have, *per* queſtion, $a+g:\frac{aR}{r}+G::q:Q$, and by multiplying extremes and means, $aQr+gqr=aRq+Gqr$, and by tranſpoſition $gQr-Gqr=aRq-aQr$; and dividing by the coefficients of a, it will be $a=\frac{gQr-Gqr}{qR-Qr}$. Therefore, to find the value of a by the rule of proportion, take the diviſor $qR-Qr$ for your firſt number, the coefficients of r, $gQ-Gq$, and let r be the third; ſo ſhall the equation be reſolved in this analogy, 2 : 1000 : 2 : 1000 *l.* A's ſtock at firſt, and $e=1500$ *l.*

Prob. 2. If A works a garden in 18 days $=t$, and B does it in 28 days $=T$, in what time will they do it together?

Here time and motion being reciprocally proportional, it will be as t, A's time, is to $G=$ the garden; ſo inverſely is T, B's time, to what he can work in the ſame time; that is, as $t:G::$ ſo inverſely $T:tG$, in which A's work is G, and B's work is $\frac{tG}{T}$. Wherefore $G+\frac{tG}{T}$, both their works in equal

time

time $:t$, the time in which they work $::G$, the work of the garden $:a$, the time required: that is $G+\frac{tG}{T}:t::G:a$; therefore, by multiplying extremes and means, $Ga+\frac{Ga}{T}=tG$; and $TGa+tGa=TtG$; and $a=\frac{TG}{TG+tG}=\frac{Tt}{T+t}$.

By which proceſs it appears, that the queſtion is to be reſolved by making the product of both given times the dividend, and the ſum of both the times the diviſor. Hence it will be 18 : 28::40:$10\frac{2}{3}\frac{2}{3}$ inverſely; or directly 40 : 18:: 28: $10\frac{2}{3}\frac{2}{3}$, anſwer.

Prob. 3. Three workmen could finiſh a certain piece of work as follows, *viz.* A once in three weeks, B thrice in eight weeks, and C five times in twelve weeks; it is required to find in what time they would finiſh it working together?

Here the powers of the agents A, B, C are ſuch as in the times 3, 8, 12, reſpectively produce effects, and it is required in what time they will produce the effect $1=a$. It will be $a=\frac{1}{\frac{1}{3}+\frac{1}{8}+\frac{5}{12}}=\frac{8}{9}$ of a week $=6$ days, $5\frac{1}{3}$ hours, *&c.*

Prob. 4. How many ancres of brandy, at 30 *s.* each, may I have in barter for 48 yards of cloth, at 10 *s. per* yard?

To find by algebra how this queſtion, and all of the ſame nature, are to be ſtated by the rule of proportion. Let N repreſent the given quantity of any commodity, here 48, and V its given value $=10$ *s. per* yard: let P repreſent the value of the other commodity for which the firſt is to be exchanged, and a the quantity required. Then it is plain that $NV=Pa$, that it is the quantity of the firſt $\times$ by its reſpective value $=$ to the quantity of the ſecond $\times$ its value. Therefore, $a=\frac{NV}{P}$, and directly $P:N::V:a$, or inverſely, $V:N::P:a$. In numbers, as 10 : 48 :: ſo inverſely 30 : 16, the anſwer. And in this manner the arithmetician may examine, and prove the truth of the rule of fellowſhip, alligation, and other arithmetical operations.

Prob. 5.

There is a cup of gold, that weighs ten ounces and fourſcore,
A ſilver cup, of the ſame ſize, weighs fifty and no more;
To caſt a cup of ſixty ſix, mix'd metal in that mould,
How many ounces muſt I mix of ſilver and of gold?

$a+e=66=M$, and $e=M-a$. $G=90 S=50 M=66$; then, as Mould. G: 1::a: $\frac{a}{G}$, the part of the mould filled with gold, and as Mould. S: 1::$M-a$: $\frac{M-a}{S}$, the part of the mould filled with silver; which two parts added must be equal to one whole mould; that is, $\frac{a}{G}+\frac{M-a}{S}=$ 1 mould. This equation multiplied and brought out of fractions will give $aS-aG+MG=sG$, and by division and transposition, $a=\frac{MG-SG}{G-S}$, which gives this analogy for a 1st, $G-S : M-S :: G : a$ 40 : 16 :: 90 : 36,

and for e $\begin{cases} G-S : G-M :: S : e \\ 40 : 24 :: 50 : 0. \end{cases}$

CHAP. XVII.

ARITHMETICAL PROGRESSION.

NUmbers in arithmetical progression are such as increase or decrease by the same common difference, as in the margin. In which it is easy to observe, that any three numbers in this progression being equally distant from each other, or exceeding each other equally, the sum of the extremes will be still equal to double the mean or middle term. For let f represent the first, s the second, t the third, let d represent the common difference, then $f+d=s$, and $f+2d=t$, and therefore the three numbers will stand f. $f+d$ $f+2d$, the sum of the two extremes, will be $2f+2d=$ double $f+d$, the mean. Also, if four numbers are in arithmetical progression, the sum of the extremes will be = the sum of the means. For then the terms will be f, $f+d$, $f+2d$, $f+3d$, the sum of the extremes, $2f+3d=$ the sum of the means.

1, 2, 3, 4, 5, 6, 7, 8, 9, &c.	
3, 7, 11, 15, 19, 23, 27, 31, &c.	
20, 18, 16 14, 12, 10, 8, &c.	

In any number of terms in this progression, the sum of the extremes is equal to the sum of any two means equally distant from the extremes, as 2 4 6 8 10 12, 2+12=4+10=6+8. For the difference of the first and second being the same with the difference of the third and fourth, the numbers will stand thus: F:F+dT:T+d, in which F+T+a=F+d+T. And hence the sum of any series of numbers in arithmetical progression is equal to the sum of the first and last added together and multiplied by $\frac{1}{2}$ the number of terms: For the sum

of

of this ſeries being compoſed of the ſum of the extremes and means, it is evident the number of extremes and means will be equal to $\frac{1}{2}$ the number of terms; alſo the difference betwixt the firſt and laſt term will be equal to the common difference of each two ſubſequent terms × the number of terms —1; as 4, 7, 10, 13, 16, 19, in which 19 —4=3×5. From this it follows, that if the number of terms is expreſſed by N, the common difference by D, the firſt term F, the laſt term L, the total ſum of the ſeries S; and if any three of theſe are given, the other two may be eaſily found, without a continued addition of the terms, as appears in the following examples,

1. A nobleman gives a penny to a beggar the firſt day of the year, twopence the ſecond day, threepence the third, and a penny more every day to the year's end; required how much he gives the laſt day of the year, and what is the total amount of the whole?

Here is given F=1 penny, D alſo =1, and N=365, the days of the year. To find L and S. Firſt, $L-F=D\times N-1$, and $L=D\times N-1+F$=365 pence given the laſt day of the year. Then $L+F\times\frac{N}{2}=S$, that is $365+1=366\times\frac{N}{2}$, or 182 =66795 pence the ſum of the whole ſeries =L. 278 : 6 : 3.

Suppoſe 500 eggs laid in a ſtraight line, at one yard's diſtance from each other, and the firſt egg one yard's diſtance from a baſket, into which a man muſt carry them one by one; required the number of yards he muſt travel?

Here F=2 yards, D alſo =2, N=500; conſequently, as before, $L=DN-1+F=2\times499$, or 998+2=1000 yards, and $S=L+F\times\frac{N}{2}$, that is, 1000+2=1002×250=250500 yards in all.

CHAP. XVIII.

GEOMETRICAL PROGRESSION.

NUmbers in geometrical progreſſion are ſuch as either increaſe or decreaſe proportionally by the ſame common ratio, as 1. 2. 4. 8. 16. 32. 64. *&c.* where the common ratio is (2), each ſubſequent term being double the preceding, or 1. 3. 9. 27. 81. 243. *&c.* where the ratio is (3), each ſubſequent term being triple the preceding, and the ſame of any other ſeries, whether increaſing or decreaſing. In any ſeries

of

of this kind, it is evident from what has been ſaid of proportional numbers in general, *firſt*, That of any three numbers of this progreſſion, the product of the extremes is equal to the ſquare of the means. *Secondly*, That of four numbers of this progreſſion, the product of the two extremes is equal to the product of the two means. And, *thirdly*, That in any ſeries exceeding four terms, the product of the means is equal to the product of the extremes, equally diſtant from theſe means; as in 1. 2. 4. 8. 16. 32. where $1\times32=2\times16=4\times8$; the reaſon of which is, becauſe theſe extremes and means are proportional by the hypotheſis, and conſequently by the general theorem their products muſt be equal. It is alſo evident, that in any ſeries of this kind, as the firſt antecedent is to the firſt conſequent, ſo is the ſum of all the antecedents to the ſum of all the conſequents; as in 2 : 4 : 8 : 16 : 32 : 64, whereas 2 : 4 : : 2+4+8+16+32=64 : 4+8+16+32+64=124; for it is plain, that as oft as the firſt antecedent is contained in the firſt conſequent, ſo oft is the ſum of all the antecedents contained in the ſum of all the conſequents. Hence, if F repreſents the firſt term of any progreſſion, L the laſt, R the common ratio, N the number of terms, S the ſum of the whole ſeries, if any three of theſe are given, the other two may be found without a continued multiplication, diviſion, or addition of the terms, as appears by the following problem.

Problem. In any ſeries of numbers in geometrical continued progreſſion, the firſt term F, the number of terms N, and the common ratio R being given, to find the laſt term L, and the ſum of the whole ſeries S, let this common queſtion be propoſed. A man bought a horſe with 7 nails in each ſhoe, 28 in all, and, by agreement, was to pay 1 farthing for the firſt, 2 for the ſecond, 4 for the third, 8 for the fourth, in double proportion till all the nails were paid for; required the price of the horſe? Here $F=1$, $R=2$, $N=28$, required L the laſt nail, and S the ſum of the whole ſeries. Since F repreſents the firſt term, FR will be the ſecond, FRR or FR^2 the third, FR^3 the fourth, FR^4 the fifth, FR^5 the ſixth, and ſo $FR^{27}=$ the twenty-eighth and laſt term; that is, if the ratio 2 is involved to the 27th power, being leſs by 1 than $N=28$, and this multiplied by $F=1$, (which in this queſtion neither multiplies nor divides), you will have L the laſt term. Now, the ratio 2 may be briefly raiſed to the 27th power, thus,

thus, $R^2=4$, $R^2\times R^2=R^4=16$, $R^4\times R^4=R^8=256$, $R^8\times R^8=R^{16}=65536$, $R^{16}\times R^8=R^{24}=16777216$, $L^{24}\times R^3=R^{27}=134217728=L$, the laſt term or number of farthings to be paid for the laſt nail. Then $S-L=$ the ſum of all the antecedents, and $S-F$ the ſum of all the conſequents; and as $F:FR::S-L:S-F$, and by multiplying extremes and means $FS-FF=FRS-FRL$, and by diviſion $S-F=RS-RL$, and by tranſpoſition $RS-S=RL-F$, conſequently $S=\frac{RL-F}{R-1}$, in words as follows.

Multiply the laſt term by the ratio, ſubtract the firſt term, divide the remainder by the ratio—unity, the quotient gives the ſum of the whole ſeries. In the queſtion propoſed, the laſt term was found 134217728, this × by 2=268435456, from which ſubtract 1, remains 268435455. This divided by the ratio—1, gives the total number of farthings paid for the horſe 268435455=279620 l. 5 *s.* 3 *d.* 3 *qrs.*

Example 2. An European having taught an Indian prince to play at cheſs, was deſired to aſk his reward. In order to give the Indian an idea of numbers increaſing in geometrical progreſſion, the European told him, that there being ſixty-four little ſquares in the cheſs-board, for the firſt he demanded only 1 ſquare inch of ground, 2 for the ſecond, 4 for the third, 8 for the fourth, *&c* and ſo forward in double geometrical progreſſion. This ſeeming at firſt a very moderate demand, was readily complied with; but the prince ſoon found it was more ground than the whole world could afford. Required the number of ſquare inches it would amount to?

Firſt, to raiſe the ratio 2 to the 63d power, $R\times R=R^2=4$, $R^2\times R^2=R^4=16$, $R^4\times R^2=R^6=64$, $R^6\times R^6=R^{12}=4096$, $R^{12}\times R^{12}=R^{24}=16777216$, $R^{24}\times R^6=R^{30}=1073741824$, $R^{30}\times R^3=R^{33}=8589934592$; then $R^{33}\times R^{30}=R^{63}=9223372036854775808$, which is the laſt term or number of ſquare inches of ground for the 64th ſquare of the cheſsboard. This multiplied by R^2, gives in all 18446744073709551615 ſquare inches. This divided by 144 ſquare inches in 1 ſquare foot, gives 128102412992741 ſquare feet. This divided by 36000000, the number of ſquare feet in a ſquare mile, reckoning 6000 feet one geographical mile, gives 35584003 ſquare miles, nearly equal to $\frac{1}{4}$ of the globe, including land and water.

CHAP.

CHAP XIX.

EXTRACTION of the SQUARE ROOT.

SInce the ſquare of any number is the product of that number multiplied into itſelf, as 2×2=4, and 3×3=9, and 9×9=81, &c. ſo reverſely, the root of a ſquare number is that number, which being multiplied into itſelf, produceth the ſquare; hence the ſquare root of 4 is 2, the ſquare root of 9 is 3, and the ſquare root of 81 is 9.

TABLE OF POWERS.

Roots	1	2	3	4	5	6	7	8	9
Squares	1	4	9	16	25	36	49	64	81
Cubes	1	8	27	64	125	216	343	512	729
Biquad.	1	16	81	256	625	1296	2401	4096	6561
Surſolids	1	32	243	1024	3125	7776	16807	32768	59049
Sq. cubes	1	64	729	4096	15625	46656	117649	262144	531441

Prob. 1. *To extract the ſquare root of a whole number.*

1. Draw a crooked line on the right of the given ſquare number, as in diviſion, where the figures of the root, or the quotient expreſſing the root muſt be placed.

2. Put a point over the unit's place, and omitting one, point every other figure towards the left hand, ſo ſhall the given ſquare be pointed into ſeveral periods of 2 figures each, the number of which periods diſcover the number of places of which the root muſt conſiſt.

3. The root of the firſt period to the left hand is found by the above table, or without any other table than that of multiplication; wherefore, place the neareſt root in the quotient, and ſubtract its ſquare from the firſt period; to the remainder annex another period, and double the quotient for a new diviſor; then conſider how often the new diviſor is contained

in all the figures excepting the unit's place, and quote the number of times; then affixing this new quotient-figure to its own diviſor, multiply the diviſor thus increaſed by the new quotient-figure, and ſubtract the product from the whole dividend as before; bring down another period, which muſt be managed exactly as the laſt, and proceed thus till all the periods be brought down; if at laſt there be no remainder, then will the quotient expreſs the true root; but ſhould there be ſomething ſtill remaining, annex periods of ciphers, and carry on the diviſion decimally, till the root be brought ſufficiently near the truth, according to the exactitude required in the ſolution of any queſtion depending thereon.

EXAMPLES.

1. Required the ſquare root of $\dot{3}2\ \dot{4}8\dot{9}$ ($567\times567=321489$ Pr.

$25=5\times5$

6 annexed to $5\times2=106)714=7$ and 14 annexed.

$636=6\times106$

7 annexed to $2\times56=1127)7889=78$ with 89 annexed.

7889

0

ILLUSTRATION.

Firſt, the unit's place 9 is pointed, omitting 8, 4 is pointed, and omitting 1 we point 2: hence as there are three points, we conclude there will be three places in the root. Then, ſince 5 is the neareſt root of 32, for ſix would be too much, as $6\times6=36$, we place 5 in the quotient, which being ſquared and ſet under 32, there remains 7, to which the period 14 is annexed. Then we double 5 for a diviſor, which becomes 10; then we will ſay 10 out of 71, (for the unit's place is not regarded), and that can be found 7 times; yet, as 7 cannot be found once in 4, we take it but 6 times, which 6 being quoted and annexed to the diviſor 10, we multiply 106 by 6, and the product is 636; the difference betwixt 714 and 636 is 78, to which the period 89 being affixed, we have a new dividual or reſolvend of 7889; the former part of the quotient being multiplied by 2, becomes 112, which is found

in 788, 7 times, and this being quoted and annexed to the divisor, makes the whole divisor 1127, which exactly corresponds to the number taken, for there is no remainder.

Exam. 2. What is the square root of 6968?

```
          6968·(83.4745, &c.
          64
        ------
   163)  568
         489
        ------
  1664)  7900
         6656
        ------
 16687)  124400
         116809
        -------
166944)  759100
         667776
        -------
1669485)  9132400
          8347425
         -------
          (784975)
```

DEMONSTRATION.

The reason of this method is founded in geometry, *Eucl. book* 2. *prop.* 4. and in algebraic multiplication. Let G represent any given number whose square root is required; let R represent the first member of that root found by the table, and e the second member, or part required to complete it: then $R+e$ is the complete root, and $RR+2Re+ee=G$ the given number, and by subtracting from both sides $2Re+ee=G-RR$, and dividing by the coefficients of e, it is $e=\frac{G-RR}{2R+e}$; which in words is the very method above explained: for, from the given number G subtract the square of the first member of the root represented by R, and divide the remainder by $2R$, or double the root, annexing the quotient figure or second member of the root, represented by e, to the said double root or divisor, by which the value of e is ascertained, the second member required; and for a third member y, the method

method is plainly the same; for then $R+e$ is the root, and is regarded as the first member, $2R+2e$ the double root, and $2R+2e+y$ the divisor for finding y, as will be evident from the following operation.

$$
\begin{array}{rl}
G= & \dot{5}5\dot{2}2\dot{5}\ (2\ ..=R \\
2R=4\ ..\ RR=4\ .... & \\
\hline
+e=3. & 152\ ....\ 3.\ =e \\
2R+2e=46. & 129\ .. \\
\hline
+y=5 & 2325\ ..\ 5\ =y \\
2R+2e+y=465 & \\
 & 2325 \\
\hline
 & (0)\quad 235=R+e+y.
\end{array}
$$

Exam. 3. What is the square root of 43623?

$$
\begin{array}{rl}
 & \dot{4}3\dot{6}2\dot{3}\ (208.\ 861.\ \&c. \\
 & 4 \\
\hline
408) & 3623 \\
 & 3264 \\
\hline
4168) & 35900 \\
 & 33344 \\
\hline
41766) & 255600 \\
 & 250596 \\
\hline
417721) & 500400 \\
 & 4\ 7721 \\
\hline
 & 82679,\ \&c.
\end{array}
$$

Note 1. If the root of a mixed number is proposed to be extracted, make the number of decimal places even, that a point may fall upon the unit's place of the integral part of the proposed number, and point off as many places for decimals in the root as there were periods in the fractional part of the square.

Exam. 4. What is the ſquare root of 751417.574560 ?

```
751417.574560(866.843
64
166) 1114
      996
1726) 11817
      10356
17328) 146157
       138624
173364) 753345
        693456
1733683) 5988960
         5201049
Rem.     787911
```

Note 2. To extract the root of a vulgar fraction ;——reduce it to its loweſt terms, if it is not ſo already, then will the root of the numerator and the root of the denominator, ſeverally extracted, be the fractional root required.——Thus $\frac{9}{16}=\frac{3}{4}$ and $\frac{49}{64}=\frac{7}{8}$, *&c.*

Note 3. To extract the root of any pure decimal, make the places of an even number, and then the operation will be the ſame as before.

What is the ſquare root of .5625 ?

```
.5625(.75
49
145)725
    725
```

What

What is the ſquare root of .1250?

```
      1250(.353
       9
     ---------
  65)350
     325
     ---------
 703)2500
     2109
     ---------
      391
```

APPLICATION OF THE SQUARE ROOT.

Prob. 1. To find a geometrical mean between any two numbers.

Multiply the given numbers into one another, and the ſquare root of their product is the geometrical mean required.

Required a geometrical mean betwixt 9 and 16?

```
      16
       9
     ---
     144(12 Anſwer
     1
     ---
  22)44
     44
     ---
      0
```

Prob. 2. To find the ſide of a ſquare, whoſe area ſhall be equal to that of any given ſurface whatever.——The ſquare root of the given content will be the ſide of the ſquare required.

Exam. There is a piece of ground in the form of a parallelogram, whoſe longeſt ſide is 134 chains, and ſhorteſt 80 chains, to be exchanged for a ſquare piece of ground cut out of a large field, of the ſame area; required the ſide of the ſquare?

134

134
80

Area of the parallelogram 10720(103.53 Anſwer.
1

203)0720
609

2065)11100
10325

20703)77500
62109

(15391)

A maltſter hath a kiln which he finds too little for his buſineſs, its diameter being only 15 feet; the diameter of another is required, which will hold double the quantity of the old one?

15×15=225 ſquare of the diameter.
2

450(21.2 Anſwer.
4

41)50
41

422)900
844

(56)

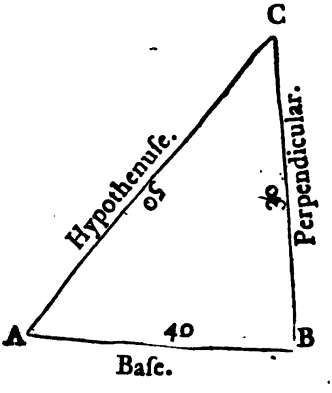
A maltſter hath a kiln which he finds too large for his buſineſs, its diameter being 21.2 feet; the diameter of another which will hold half the quantity is required?

21.2×21.2=450 nearly.

Then $\frac{450}{2} = 225$(15. Anſwer.

Prob.

Prob. 3. Having any two ſides of a right angled triangle given to find the third, the ſum of the ſquares made upon the baſe and perpendicular, is equal to the ſquare made upon the hypothenuſe, *per* 47. *b.* 1. *Euc. Elem.*



Therefore to find A C, extract the ſquare root of the ſum of the ſquares of A B, and B C.

To find A B, or B C, the ſquare root of the difference of the ſquares of the other two will give that required.

EXAMPLES.

A B = 40
B C = 30 to and A C 40×40=1600
30×30= 900

2500(50=A C.

A C = 50
A B = 40 and B C 50×50=2500
40×40=1600

900(30=B C.

A travels north 50 miles, and B travels eaſt 60 miles; how many miles are they diſtant?

50×

50×50=2500
60×60=3600

6100 (78 miles, *Anſ.*
49

148)1200
1184

16

The ſemidiameter of the earth being 3984.58 miles, and the perpendicular height of a mountain 3 miles; how far will it be ſeen at ſea, or on plain ground, ſuppoſing the eye of the ſpectator to be on the ſurface of the ground or water?

3984.58 ſemidiameter
3 height.

3987.58×3987.58=15900794.2564
3984.58×3984.58=15876877.7764

23916.4800(154.64 miles.
1

25)139
125

304)1416
1216

3086)20048
18516

30924)153200
123696

(29504)

Prob. 4. The diameter and capacity of one circle being given, to find the diameter of another circle, that ſhall have any proportional capacity, greater or leſſer than the circle whoſe diameter and capacity is given.

Since

Since the areas, or capacities of circles are to one another as the ſquares of their diameters. *per prop.* 2 *b.* 12, of *Euc. Elem.* it will be, as the ſquare of the diameter of any circle is to its area or capacity, ſo is the ſquare of the diameter of any other circle to its area, and *vice verſa.*

Exam. 1. If the diameter of a circle be 6, and its area 28.2742; what will be the area of another circle whoſe diameter is 8?

36 : 28.2742 :: 64
9 16

9)452.3872

50.2652

Exam. 2. If the diameter of a circle, whoſe area is 50.2652, be 8, what is the diameter of that circle whoſe area is 28.2742?

50.2652 : 64 :: 28.2742 : 36, the ſquare of 6, the anſwer.

CHAP. XX.

The EXTRACTION of the CUBE ROOT.

AS in a ſquare, which is the ſecond power, every ſecond figure from the right hand is to be pointed, ſo, in a cube, which is the third power, every third figure, beginning with the unit's place, is to be pointed in the like manner. Then find, by the table of cubes, the neareſt cube to the firſt pointed period of the reſolvend, the cube root of which place in the quotient to the right hand, and ſubtract the cube thereof from the firſt pointed period, bringing down to the remainder the ſecond period.

Secondly, For a diviſor to this reſolvend, take thrice the ſquare of your firſt quotient-figure, either annexing, or ſuppoſing tobe annnexed thereunto, a competent number of ciphers, according to the number of points in the given reſolvend; by which find the ſecond quotient-figure of the required root.

Thirdly, To your diviſor, which was thrice the ſquare of your firſt quotient-figure, annex thrice the ſame quotient-figure, multiplied by the ſecond, and alſo the ſquare of the ſecond; and in this obſerve, to advance the figures annexed one ſtep further, to the right hand; and then multiply the diviſor thus increaſed by your ſecond quotient-figure, and ſubtract the product from the reſolvend.

Fourthly, To your remainder bring down your next period, and find a new diviſor, as you did the firſt; by taking thrice the ſquare of the two figures, of which the root or quotient now conſiſts, and, having divided and noted down your third quotient-figure, annex to your diviſor triple the two firſt figures, and the ſquare of the third, obſerving, as before, to advance the annexed figures a ſtep to the right hand. Continue this method till all the periods of the reſolvend are taken down, and then, if the propoſed number be a perfect cube, there will be no remainder; but, if ſomething ſhould remain, annex ciphers, three at a time, and carry on the extraction, decimally, to any propoſed degree of exactneſs, as in the extraction of the ſquare root.

EXAMPLES.

1. Required the cube root of 13824?

13824(24 the root required.

2×2×2=8

5824 For 24×24×24=13824.

2×2×3=12..
2×3×4= 24.
4×4 = 16

Diviſor 1456 × 4 = 5824

(0)

2. Required the cube root of 14886936?

148 &c.

```
14886936(246
8
1456)6886
5824
177156)1062936
1062936
(0)
```

Illuſtration of the laſt example.

Having pointed the propoſed cube, I find the root of the firſt period to be 2, which is noted in the quotient, and its cube being ſubtracted from the firſt period, there remains 6; to which another period being annexed, there is a new reſolvend of 6886. To find a diviſor for this reſolvend, upon a piece of waſte paper, I take the triple ſquare of the quotient-figure, 2=12, which I conſider as 1200, and note 4 in the quotient. Then, $3\times2\times4=24$

And $4\times4=16$

Diviſor 1456 completed.

The diviſor being multiplied into 4, and the product ſubtracted from the laſt reſolvend, the remainder, with another period annexed to it, conſtitutes the new reſolvend 1062936. Then on a piece of waſte paper, as before.

$24\times24\times2=1728$ which I conſider as 172800, and
$3\times24\times6=432$ note 6 in the quotient.
Then $6\times6=36$

Diviſor 177156 completed.

Which being multiplied into 6, and the product ſubtracted from the reſolvend, leaves no remainder, and the root is 246; which, being involved, will be found equal to the given cube.

3. Required the cube root of 27407028375?

$$\begin{array}{r} \dot{2}74\dot{0}70\dot{2}8\dot{3}75(3015 \\ 27 \\ \hline 270901)407028 \\ 270901 \\ \hline 27225475)13\dot{6}127375 \\ 136127375 \\ \hline (0) \end{array}$$

DEMONSTRATION.

Let G represent any given cube, the root whereof, a, is required; let r represent the nearest root to the first period of the pointed cube, and e what r wants of the just root.

Then $r+e=a$

$rr+2re+ee=aa$

$r^3+3rre+3ree+e^3=a^3=G$

By subtracting r^3. $3rre+3ree+e^3=G-r^3$
and dividing by the coefficients of $e=\dfrac{G-r^3}{3r^2+3re+e^2}$

Which being expressed in words, we have this rule. From the given cube, subtract the cube of r. *i. e.* the cube nearest to the first period: divide the remainder by thrice the square of r, the first quotient figure, annexing thereto thrice the said first figure multiplied by the second, and also the square of the second; which in effect is the rule given above.

APPLICATION of the CUBE ROOT.

The cube root is of singular use in mathematics; but as mercantile computations ingross our present attention, we shall only give a few instances, and therewith conclude this part.

Prob. 1. To reduce any solid to a cube. The cube root of the solid content of any figure is the side of a cube, whose solidity shall be equal to that of the figure given.

Ex.

Ex. Suppoſe a box or cheſt, whoſe length is 24, breadth 9, and depth 8 inches; required the ſide of a cube whoſe ſolid content ſhall be equal thereto?

Length 24
Breadth 9

216
Depth 8

1728(12 Anſwer.
1

364)728
728

0

Prob. 2. Having the dimenſions of a ſolid given, to determine the dimenſions of a ſimiliar, or like ſolid, that ſhall be any number of times greater or leſs than that given.—Cube the given dimenſions, and multiply their ſeveral cubes by the difference, if the ſolid required is greater than the given one; or divide the ſeveral cubes by the difference, if the required ſolid be leſs than that given.

Ex. What will be the ſide of a cube that ſhall contain four times as much as that cube whoſe ſide is 12?

12×12×12=1728
4

6912(19.04
1

651)5912
5859

10852816)53000000
43511264

9488736

Prob.

Prob. 3. To determine the dimenſions of a ſimilar ſolid, by having the dimenſions or capacity of a ſimiliar ſolid given.

Ex. If a ſhip of 100 tuns be 44 feet long at the keel, of what length ſhall the keel of that ſhip be, whoſe burthen is 220 tuns?

$$\sqrt[3]{\frac{44\times44\times44\times220}{100}}=57.225.$$ Anſwer.

2. Let the length of a ſhip's keel be 125 feet, and the breadth of the midſhip beam 25 feet, and the depth of the hold 15 feet; I demand the dimenſions of another ſhip of the ſame figure, that ſhall carry three times the burthen of the given ſhip? The cube roots of the cubes of the reſpective given dimenſions, multiplied by 3, will produce the ſeveral dimenſions required; *viz.*

The length of the keel - -	215.9 feet.	Anſwer.
Breadth of the midſhip beam	36 feet.	
Depth in the hold - - -	21.6 feet.	

3. Suppoſe the length of a ſhip's keel be 76.95 feet, the breadth of the midſhip beam 29.58 feet, and the depth in her hold 14.877 feet; required the dimenſions of another ſhip of the ſame mould, that will carry only 72 tuns burthen?

The ratio of the given dimenſions is 5, for $\frac{360}{72}=5$; wherefore, if the given dimenſions are ſeverally divided by the cube root, the ratio, the quotients will be the dimenſions required; *viz.*

Length	45
Breadth	17.3
Depth	8.7

4. Required the ſide of a cube that will be equal in capacity to a veſſel which contains 1728 ſolid inches?

$$\sqrt[3]{1728}=12$$

5. Suppoſe a cannon ball, 3 inches diameter, to weigh 54 ounces Avoirdupois; what muſt the diameter of that mould be, in which another ball weighing 27 pounds may be caſt?

54:

54 : 3×3×3 :: 432
Abridged 2 : 1 :: 432 : $\sqrt[3]{216}$=6 inches, Anſwer.

6. Suppoſe a carpenter is employed to make a cubical veſſel, of equal length, breadth, and depth, which ſhall juſt contain 100 Scots gallons of wort; required the dimenſions thereof?

100 gallons.
872 ſolid inches in a Scots gallon.
$\sqrt[3]{187200}$=44.34 inches, the length, breadth, and depth required.

7. Required to make a girnal, which ſhall contain 1500 buſhels of malt, whoſe length ſhall be double the breadth, and the breadth and depth equal?

Firſt, 2150 ſolid inches in a buſhel.
1500 buſhels.

3225000 the ſolid content in inches.

2*dly*, Put a for the required length, the breadth and depth will be each $\frac{1}{2}a$; therefore by multiplying length, breadth, and depth together, we have $a \times \frac{1}{2}a \times \frac{1}{2}a = \frac{1}{4}aaa = S$ the ſolid content, and $aaa = 4S$. If therefore we multiply the ſolid content by 4, and extract the cube root of the product, we have the required length, $\frac{1}{2}$ whereof gives the breadth, to which the depth is equal.

Hence 3225000
4
$\sqrt[3]{12900000}$=234.54 inches = the length.
$\frac{1}{2}$=117.27 inches = the breadth.

8. Suppoſe a ſhip 150 tuns burden, and the dimenſions as follow: 65 feet by the keel, 18.5 by the beam, and as much depth in the hold, by which a carpenter is to proportion the dimenſions of another ſhip of 1200 tuns burden; required the length of her keel, and other dimenſions in proportion?

Firſt,

First, $150 : 65 \times 65 \times 65 :: 1200 : \sqrt[3]{2497000} = 130$ the length.
2dly, For the breadth and depth.
$65 : 18.5 :: 130$
Abridged $13 : 3.7 :: 130 : 37$ the breadth.

RECAPITULATION of the principles of Arithmetic and Algebra.

AXIOM I.

Since whole numbers increase, and decimals decrease in a decuple proportion, 10 is the universal ratio of any series of numbers whatever; and the reason for carrying at 10 in addition and multiplication is self-evident, since 10 in any place to the right is equal to 1 in the next place to the left. Hence also the reason for carrying according to the subdivisions of any integer, when several denominations are to be added.

AXIOM. II.

If two numbers are equally increased, their difference is always the same. Hence the reason of borrowing 10 in one place to the right, and paying it back by carrying 1 to the next place. Hence likewise the reason will be evident, for placing the first figure to the right of the product of every particular multiplier directly below its own multiplier.

AXIOM III.

The multiplicand will be increased or diminished, in proportion to the multiplier, when the same multiplicand is used. Hence the reason why the multiplicand is encreased, when it is multiplied by any thing greater than unity, and decreased when it is multiplied by a fraction.

AXIOM IV.

The dividend will be increased or diminished in proportion to the divisor, when the same dividend is used. Hence to divide by any thing greater than unity, will quote a number less than the dividend; and, on the contrary, to divide by any thing less than unity, will quote a number greater than the dividend.

AXIOM V.

The whole is equal to all its parts taken together. Hence one ſum may be made equal to ſeveral by addition, and ſubtraction may be proved by adding the difference to the leaſt given ſum.

AXIOM VI.

If equal quantities are added to equal quantities, the ſums will be equal; and if equal quantities are taken from equal quantities, the remainders will be equal. Hence the reaſon of the reduction of equations by addition and ſubtraction.

AXIOM VII.

If equal quantities are either multiplied or divided by other equal quantities, the products and quotients will reſpectively be equal. Hence the reaſon of reducing equations by multiplication and diviſion, and of abridging commenſurable terms, and cancelling equal quantities and numbers.

AXIOM VIII.

To multiply any quantity or number by other quantities or numbers continually, is the ſame as to multiply by the product of theſe other numbers. Hence the reaſon of multiplying by component parts, *&c.*

AXIOM IX.

To divide one number or quantity, by other numbers or quantities continually, is the ſame as to divide that one quantity or number by the product of the reſt. Hence the reaſon of dividing by component parts, *&c.*

AXIOM X.

If four numbers or quantities are proportional, the rectangle or product of the extremes will be equal to the product of the means; and, *vice verſa*, if the product of the extremes be equal to that of the means, the numbers or quantities are proportional.

AXIOM XI.

The quotient of any two ſucceeding powers, when the next higher is divided by the next lower, exhibits the root of

theſe powers. On the contrary, if any power is multiplied by the root of that power, the product will be the next higher power of the root; and if a higher power is divided by the root, the quotient will exhibit the next lower power. Again, if a proportional part of a higher power is divided by a proportional part of the next lower power, the quotient will exhibit a proportional part of the root. Hence the firſt figure or figures in the root of any power being raiſed to the power next lower than that whoſe root is wanted, and that power multiplied by a number expreſſing the proportion which the given power bears to its root, produces a proportional diviſor, whoſe ratio, compared with the dividual, is a proportional part of the root, which being annexed to the former part of the root, and raiſed to the full power of the given number, will be either the whole, or a proportional part of the given power, diſcoverable by ſubtraction, &c. Hence we have a general rule for extracting the root of any power whatever.

THE

THE

UNIVERSAL ACCOUNTANT.

PART. IV.

The Application of Arithmetic to the Buſineſs of the Merchant, the Banker, Cuſtom-houſe, Inſurance-office, &c.

CHAP. I.

Simple PROPORTION, or RULE of THREE.

PRoportion may be defined in general, The identity, ſimilitude, or equality of ratios, as ratio is the relation, or habitude of two numbers, which determines the value of the one from the value of the other; for inſtance, the ratio of 4 and 8 is 2, and the ratio of 8 and 16 is likewiſe 2; hence, the relation betwixt 4 and 8, and 8 and 16 being the ſame, theſe four numbers are ſaid to be in proportion.

The rule of proportion, or rule of three, finds a fourth proportional to three numbers given, one of which ſhall have the ſame ratio to that fourth, which exiſts betwixt the remaining two, as was demonſtrated in the algebraic part. But to ſpeak in applicate terms:

Proportion is that rule, by which the value, quantity, or number of one ſpecies of things is proportioned to the value, quantity, or number of another ſpecies of things, according to ſome fixed ſtipulation, or known concluſion. For inſtance, if I purchaſe 4 yards of cloth for 10 ſhillings, and then agree to take the piece of 16 yards at the ſame price *per* yard; it is plain that the thing required here, is to proportion the price of 16 yards to the price ſtipulated for 4 yards, by ſtill preſerving the ſame ratio betwixt 16 yards and the price there-

of, as betwixt 4 yards and the ſtipulated price of 10 ſhillings.

yds. s. yds.

Thus, 4 : 10 :: 16:40; in which 16 hath the ſame ratio to 50 that 4 hath to 10, and 10 the ſame ratio to 40 that 4 hath to 16.

All queſtions in this rule are either in a direct or reciprocal proportion.

1. Direct, when the firſt bears the ſame ratio to the ſecond, as the third doth to the fourth; in which caſe, the greater the ſecond term is in reſpect to the firſt, the greater will the fourth term be in reſpect to the third, and the contrary. 4: 10:: 16:40. Here, becauſe 10 is greater than 4, 40 is proportionally greater than 16; and 40: 16:: 10:4. Here, becauſe 16 is leſs than 40, 4 is of conſequence leſs than 10 in the ſame proportion. Hence we have this corollary for proving all operations in direct proportion; that the product of the extremes will always be equal to that of the means: for it is plain, that 4 ×40=10×16

and that 40× 4=16×10

2. Reciprocal, when the third bears the ſame ratio to the firſt, as the ſecond doth to the fourth; in which caſe the leſs the third term is in reſpect to the firſt, the greater will the fourth term be in reſpect to the ſecond, and *vice verſa*. For inſtance: Suppoſe 8 men could do a certain piece of work in 4 days, and it were required to know in what time 16 men could do it; upon the leaſt conſideration it would occur, that 16 hands would do more work than 8, and conſequently require leſs time wherefore, as 8 : 4 :: 16 : 2. In which 16 bears the ſame proportion to 8 that 4 doth to 2; and by ſhifting the ſuppoſition, 16: 2 : : 8 : 4. Hence, when the terms are in reciprocal proportion, the product of the two firſt terms will always be equal to the product of the two laſt.

For 8×4=16×2, and 16×2=8×4.

From the foregoing conſiderations are deduced the following rules.

1. For ſtating, or ranking the numbers in a proportional order. Make that number the third term upon which the demand lies; that number the firſt term which is of the ſame kind, or ſignifies the ſame thing, with that term which was made the third; then will the remaining one, which is to poſſeſs the ſecond place, be of the ſame kind, or ſignify the ſame thing, with the fourth, or number required.

2. For finding a fourth proportional. If the terms are in direct

direct proportion, that is, if more require more, or less require less, the product of the two last divided by the first will quote the answer, or 4th proportional.——But if the terms are in reciprocal proportion, that is, if more require less, or less require more, the product of the two first divided by the last will quote the answer.

EXAMPLES.

1. Bought 1420 yards of ozenbrigs, at 12 *s.* the score, of 20 yards; what will be the charge of the whole?

yds. *s.* *yds.* *L.* *L* *s.*

First 20 : .6=12 :: 1420 : 42.6=42-12

For 1420

.6

2|0)85.20

42.6

And 20×42.6=.6×1420

2. It is computed that 6 men would build a wall in 40 days, but the proprietor would have it finished in 10 days; how many men, according to that computation, must be hired for building the wall?

days *m.* *days* *m.*

First 40 : 6 :: 10 : 24

For $\frac{40\times6}{10}$=24 men.

and 40×6=10×24.

Illustration of the last two Examples.

In the first example, the number upon which the demand lies is 1420 yards, and therefore by the rule it stands in the third place; the correspondent number to 1420 yards must be that one of the other two which implies yards, or some denomination of that integer, which in this case is found to be 20 yards, and therefore by the rule adopted for the first term: but to prove that we are so far right, we have still another check, namely, that the remaining term for the second place must be money, because by the question the answer must be money.

money: here we find it is 12 ſhillings, and therefore we may conclude that the terms are properly ſtated. Next, we conſider that the 3d term, 1420 yards, contains a greater quantity than the firſt term, 20 yards, and conſequently requires a greater price; therefore we conclude the terms to be in direct proportion, and find the anſwer, by dividing the product of the two laſt terms by the firſt.

In the ſecond example the demand lies upon ten days for the 3d term, to which 40 days correſpond for the firſt; and 6 men muſt be the ſecond, becauſe it correſponds with what is required. It will likewiſe be obvious, that to finiſh any work in ten days, will require more men than it would do to finiſh it in 40 days, and therefore we conclude that the terms are in reciprocal proportion.

OBSERVATION.

When the terms are mixed numbers, or of different denominations, they may be made homogeneal by reduction, vulgar fractions, or decimals; and the operations thereafter abbreviated, when poſſible, in any of thoſe methods propoſed in the firſt part, which may ſeem moſt adapted to the purpoſe; or by other methods which judgement and experience may dictate, equally, and perhaps ſtill better calculated for diſpatch.

To give a more particular idea of my meaning, I ſhall vary the work of the next queſtion, by different methods of operation, and afterwards give the ſolution of others in that method which bids faireſt for diſpatch, which, next to accuracy, ought to be the principal object attended to by an accountant; and though ſome figures that are not neceſſary to the operation, ſuch as the ſtating of the queſtions, for the ſake of illuſtration, may be introduced, no figure ſhall be omitted, for the ſake of an affected brevity, which I myſelf have occaſion to uſe in the operation.

Queſt. 3. If for $5\frac{1}{4}$ yards of velvet I get *L.* 4, 12 *s.* what may I reckon $84\frac{1}{2}$ yards worth, which is all that I have of the kind?

1. By

1. By reduction.

Yds.		*L. s.*		*Yds.*		*L. s.*
$5\frac{1}{4}$	:	4-12	::	$84\frac{1}{2}$	:	67 12
23 qrs.		20		338 qrs.		
		92 s.		92		
				676		
				3042		
				23) 31096		
				20) 1352 s.		
				L. 67-12		

2. By vulgar fractions.

Yds.	*L.*	*L.*		*Yds.*	*L.*
$\frac{23}{4}$:	$\frac{92}{20}$ or	$\frac{23}{5}$	::	$\frac{169}{2}$	: $\frac{15548}{230}$

For $\frac{23 \times \frac{169}{2}}{5 \times 2} = \frac{3887}{230} = L.6712$

$\frac{23}{5}$

3. By decimals.

Yds.	*L.*	*Yds.*
5.75 :	4.6 ::	84.5

Abridge the dividing and multiplying terms equally by 5, and they will ſtand.

	1.15 :	4.6 ::	16.9
Again	.23 :	4.6 ::	3.38
by 23	.01 :	.2	.2
		.01)	.676
			67.6

4. By

4. By component parts.

Yds.	*L. s.*		*Yds.*		*L. s.*
5	4 12	::	$84\frac{1}{2}$	:	67-12

7

32 4
12

386 8 into 84
2 6 into

23)388 14

16 18
4

L. 67 12 *Anſwer.*

Many of theſe figures might have been omitted but for illuſtration.

5. By multiplying the number of yards $84\frac{1}{2}$ into the price of 1 yard, $\frac{1}{4}$ of which is found by dividing the given price 92 *s.* by the number of quarters in the firſt term 23, and the quotient will be 4 *s.* which multiplied by 4, produces 16 *s.* then $16 \times 84\frac{1}{2} = 1352$, as formerly.

6. Or take $\frac{1}{4}$ for 4 *s.* of 338 quarters, and you will have *L.* 67, 12 *s.* as before.

7. Or multiply 84.5 by .8, the decimal of 16 *s.* and it will produce *L* 67, 12 *s.*

Queſt. 4. Bought 36 pipes of wine for *L.* 1221 : 19 : 10, how may I ſell it *per* pipe to ſave one for my own uſe, and loſe nothing on the purchaſe?

Note, When one pipe is deduced, there remains 35, to be valued at the given price. Therefore,

Pipes.	*L.*	*s*	*d.*	*Pipe*	*L. s. d.*
35 :	1221-	19-	10 ::	1 :	34-18-$3\frac{1}{4}$

For 5) 1221 19 10

7) 244 7 $11\frac{1}{4}$

34 18 $3\frac{1}{4}$

Queſt.

Queſt. 5. The perpendicular height of my ſtaff from the ground is 4 feet 3 inches, and it caſts a ſhadow of 5 feet 6 inches; what is the height of a ſteeple which caſts a ſhadow of 573 feet 9 inches at the ſame time of the day?

By reducing the inches to decimals, which is done mentally, and dividing the two firſt terms by 5, the terms will ſtand thus:

Sha.		*H.*		*Sha.*		*H.*
1.1	:	.85	::	573.75	:	$443.4\frac{3}{11}$

For 573.75
.85

286875
459000

1.1) 487.6875 Feet. Inch.

$443.352 = 443 - 4\frac{3}{11}$ *Anſwer.*

Queſt. 6. What will 245 days ſalary amount to at 85 guineas *per annum*?

Becauſe the third term is days, the firſt term will be 365 days=1 year, and that term and the third being each divided by 5, the terms will ſtand abridged thus:

Days.	*L.*		*Days.*	*L.*	*s.*	*d.*
73	: 89.25	::	49	: 57	18	$1\frac{1}{2}$

For 89.25
7

624.75
7

73) 4373.25

$59.907 = L.\ 59\text{-}18\text{-}1\frac{1}{2}$

Queſt. 7. How much printed paper $\frac{1}{4}$ of a yard broad will line a room 70 yards in circumference, and 6 yards high?

	Br.		Length.		Br.		Length.
Reciprocally, as	6	:	70	::	.75	:	560
For			70				70
			6		or		24
			5) 420.00				3) 1680
			5) 8400				560
			3) 1680				
			560 *Answer.*				

Or abridged.

Thus,	Thus,	Or thus,
14	14	70=6×4÷3
6	2	8
.15) 84	.05) 28	560
560	560	

Quest. 8. What may one save at the year's end, who hath *L.* 456, 15*s.* *per annum*, and spends only *L* 4, 13*s*, 4 d. *per* week?

First find what he spends a-year.

Week.	*L.*	*s.*	*d.*	*Weeks.*	*L.*	*s.*	*d.*
1 :	4 -	13 -	4 ::	52 :	242 -	13 -	4

For	4,,13,,4		or	$^{3}\|52$	He hath *L.*	456	15	0
	10			$4\frac{2}{3}$	He spends	242	13	4
	5) 46	13	4	208	He saves	214	1	8
			5	17 6 8				
	233	6	8	17 6 8				
	9	6	8	242 13 4				
He spends annually	242	13	4					

Quest. 9. *A* can ditch 40 roods in 20 days, *B* can do it in 30; in what time will they do it together?

This

This requires two operations.

Days. R. Days. R.
First, for what *A* can do in *B*'s time, 20 : 40 :: 30 : 60
R. R. D. R. D.
For what time they will take together, 60×40:30::40:12 *Anſ.*

Queſt. 10. If ten men or 14 women can drink a butt of beer in 87 days, in what time would 4 men and 6 women drink it?

M. W. M. W.
First, 10 : 14 :: 4 : 5.6
W. Days. W. W.
Then, 14 : 87 :: 5.6+6 reciprocally : 105 days.

For 87
14

11.6) 1218.0

105 days. *Anſwer.*

Queſt. 11. When the buſhel of wheat ſold at 10*s.* the fourpence loaf weighed 4½ *lb.* what ſhould the ſixpence loaf weigh, when the buſhel of wheat ſells at 15*s.*?

s. lb. s.
First, 10 : 4.5 :: 15 reciprocally : 3
d. lb. d. lb
And, 4 : 3 :: 6 : 4½

Theſe numbers are ſo ſimple, that the operation may be entirely mental.

Queſt. 12. There is a caſe 6 feet 9 inches long, 5 feet 3 inches broad, and 7 feet 6 inches thick, what freight will it pay at *L* 6, 10*s. per* tun?

6.75
$5\frac{1}{4}$

33.75
1.6875

35.4375
$7\frac{1}{2}$

248.0625
17.71875

Feet. *L.*
40 : $6\frac{1}{2}$ :: 265 78125 : 43.1895
$6\frac{1}{2}$

1594.68750
132.890625

40) 1727.578125

43.1895=*L.* 43 3 9

Queſt. 13. A merchant, in balancing his books, finds he is due *L.* 575, 17 *s.* and that his whole ſubject taken together goes no higher than *L.* 487, 18 *s.* 6 *d.*; how much may he offer his creditors of the pound?

Debt. *Subject.* *D.* *Sub.*
575.85 : 487.925 :: 1 : 16 $11\frac{5}{7}$
s. *d.*

For 575.85)487.925(.847=16 $11\frac{5}{7}$ *Anſwer.*
460680

272450
230340

421100
403095

18005

Queſt. 14. A merchant wants a piece of ground before his land or tenement paved with ſtones, 3 feet by 2; the ground is 30 yards by 4; required the number of ſtones?

Feet.

		30	
		4	
Feet.			
3		120	
2		9	
—	*St.*		
6	: 1 ::	1080	: 180 *Stones.*

For 6) 1080

180 *Anſwer.*

Queſt. 15. If I lend a friend *L.* 200 for 6 months, how long ought I to retain *L.* 500 of his at another time to indemnify myſelf?

L.	*m.*	*L.*	*m.*
200	: 6 ::	500	: $2\frac{2}{5}$ *Anſwer.*

Queſt. 16. When *L.* 36 valued rent pays 4 *s.* 10 *d.* of ceſs; what will *L.* 70 pay?

L.	*s.*	*d.*	*L.*	*s.*	*d.*
36	: 4	10 ::	70	: 9	$4\frac{7}{9}$

7

33 10

5

6) 169 2

3) 28 $2\frac{5}{9}$

s. 9 $4\frac{7}{9}$ *Anſwer.*

The following queſtions are propoſed and anſwered, but the young practitioner is referred, for the method of ſolution, to the application of the foregoing.

Queſt. 17. Suppoſe a purchaſe is made of 5 pieces Dutch holland, each meaſuring 56 Flemiſh ells, at 3 *s.* 2 *d. per* ell Flemiſh, what will be gained upon the whole, if it is ſold at 5 *s.* 8 *d. per* ell Engliſh? *Anſwer L.* 3, 5 *s.* 4 *d.*

Queſt. 18. When wheat was at 12 *s.* the buſhel, the 6 *d.* loaf weighed 1 lb. 4 oz. what ought it to weigh when the wheat falls to 9 *s.* 6 *d.*? *Anſwer* 1 *lb.* 8 *oz.* 4 *pwts.* 3 *gr.*

Queſt.

Queſt. 19. There is an iſland 134 miles in circumference, in which at the ſame inſtant, and from the ſame point, *A* and *B* ſet out back to back, to travel round it. *A* travels 11 miles every 2 days, and *B* 17 every three days After what time, and how many miles travel to each, will they meet? *Anſwer*, *A* will travel 66 miles, *B* 68, and they will meet in 12 days?

Queſt. 20. If the longeſt end of the beam of a balance be 36 inches, and the ſhorteſt 27; how much ſuſpended on the ſhorteſt end will equiponderate 84 *lb.* on the longeſt end? *Anſwer* 112 *lb.*

CHAP. II.

COMPOUND PROPORTION.

IN this rule five numbers are given to find a ſixth proportional, which may be anſwered by two ſucceſſive operations in the laſt rule, but much more expeditiouſly as follows.

Of the given numbers three are conditional, or ſuppoſed, and the other two move the queſtion; therefore, of the three conditional terms, let that which is the principal cauſe of gain or loſs, increaſe or decreaſe, action or paſſion, be put for the firſt term; that number which denotes diſtance of time or place be put for the ſecond term, and the remaining number which will denote action, paſſion, gain or loſs, be put for the third term, then place the other two terms which move the queſtion in the ſame order with the preceding.

Rule 1. If the term ſought be of the ſame name with the firſt or ſecond, multiply the 1ſt, 2d, and laſt terms continually for a dividend, and the other two for a diviſor, the quotient ariſing therefrom will be the 6th proportional.

Rule 2. But if the term ſought, be of the ſame name with the 3d, the continued product of the three laſt terms, divided by the product of the firſt two, will quote the ſixth proportional.

Queſt. 1. If 8 men receive *L.* 4, 16 *s* for 6 days work; how many men may be paid with *L.* 19, 4*s.* for 16 days work?

men. days. L. days. L.
8 : 6 :: 4.8 : 16 : 19.2

ILLUSTRATION.

If 8 men for 6 days work receive *L.* 4, 16 *s.* Theſe are the conditional or ſuppoſed terms in the queſtion, and therefore poſſeſs the three firſt places; 8 men, as being the cauſe of action, or gain, make the firſt term; 6 days, as being the ſpace of time, make the ſecond, and the money which is gained in that time becomes the third term: then, becauſe days are put before money in the conditional terms, 16 days ſtand befor *L.* 19.2 in the terms which move the queſtion. When the terms are compared, it occurs at once that a number of men is demanded, and therefore the queſtion is wrought by the firſt rule, and may be previouſly abridged as follows.

	men.	*d.*		*L.*	*d.*		
State reſumed	8	6	::	4.8	16	:	19.2
	1	1		.8	2)		24
				.1			

12 *Anſwer.*

Here it is neceſſary only to divide 24 by 2 after the terms are abridged, whereas otherwiſe the proceſs would have been,

$$\frac{8\times6\times19\,2}{6\times4.8}=12$$

Queſt. 2 If the intereſt of *L.* 100 for one year is *L.* 5, what will be the intereſt of *L.* 5780 in 120 days?

L.	*days.*	*int.*	*L.*	*days.*
100	: 365 :	*L.* 5	:: 5780	: 120
	73	1	120	

73) 6936.00

L. 95 0 $3\frac{1}{73}$

Here the term ſought was of the ſame kind with the third, and the anſwer found by the ſecond rule.

OBSERVATION.

If we put N= the given number of men in the firſt queſtion, *t*=6 days, their time, S=*L.* 4, 16 *s.* their wages, T=16 days, the time propoſed in the queſtion, P=*L.* 19, 4 *s.* the ſum propoſed, and *a*= the number of men required.

If we ſtate it twice, it will be

1. S : N :: P : $\frac{PN}{S}$ the number of men in equal times.
2. *t* : $\frac{PN}{S}$ :: T : *a*.

By

By multiplying extremes and means, it will be

$ta = \frac{PNT}{S}$, and $Sta = PNT$

and by diviſion

$a = \frac{PNT}{St}$ according to the rule, and ſo of any other.

Queſt. 3. An undertaker contracted to finiſh 500 yards of turnpike in 30 days, and for that purpoſe hired 60 men; but, at the expiration of 20 days, he found he had only got the length of 260 yards; how many men muſt be added to finiſh the work in the ſtipulated time?

m. *d.* *yds.* *d.* *yds.*
60 : 20 :: 260 : 10 : 240

500
260
240

By abridging the terms, and cancelling an equal number of ciphers.

m. *d.* *y.* *d.* *yds.*
It will be 6 : 1 :: 13 : 1 : 40

Then $\frac{6 \times 1 \times 240}{13} = 110$ *men.* from which deduce the men he had, *viz.* 60

50 to be added.

All queſtions in this rule may be readily proved by multiplying the diviſor into the quotient, the product of which muſt always be equal to the dividend; or by ſhifting the conditions of the queſtion thus: If 103 men in 10 days can finiſh 240 yards, how many yards may 60 men finiſh in 20 days, *&c.*

CHAP III.

RULE OF CONJUNCTION.

THE rule of conjunction joins together ſeveral ſtatings in the rule of proportion into one, and by the relation that ſeveral antecedents have to their conſequents, the proportion between the firſt antecedent and the laſt conſequent is diſcovered, as well as the proportion between the others in their ſeveral reſpects.

To diſpoſe this rule aright, the antecedents muſt be ranged in the left hand column, and the conſequents in the right hand one,

The firſt antecedent and the laſt conſequent, whoſe antecedent is ſought, muſt be of the like ſpecies; ſo muſt the ſecond conſequent and the third antecedent; and this order muſt be continued throughout the whole.

The terms being thus diſpoſed, the diviſor is found by multiplying all the antecedents into one another continually, and the dividend by multiplying all the conſequents in the ſame manner, the quotient ariſing from theſe two factors gives the antecedent required.

This rule may be ſo abridged by cancelling equal quantities and abbreviating commenſurables, that the whole operation may be performed with very little trouble.

EXAMPLES.

1. Suppoſe 100 *lb.* of Amſterdam=100 *lb.* of Paris, 100 *lb.* of Paris = 150 *lb.* of Genoa, 100 *lb.* of Genoa = 70 *lb.* of Leipſic, 100 *lb.* of Leipſic = 160 *lb.* of Milan, how many *lbs.* of Milan will equiponderate 548 *lb.* of Amſterdam?

Antecedents. *lb.*	Conſequents. *lb.*	Abridged. Ant.	Con.
100 of Amſterdam	=100 of Paris.	5	3
100 of Paris	=150 of Genoa.	5	2
100 of Genoa	= 70 of Leipſic.		7
100 of Leipſic	=160 of Milan.		548
How many of Milan	=548 of Amſterdam. ?		

Then $\frac{3\times2\times7\times548}{5\times55}$ = 920$\frac{16}{55}$ *lb.* of Milan=548 *lb.* of Amſterd.

ILLUSTRATION.

The two 100's on both ſides cancel each other, and let the laſt cipher of the three remaining antecedents be cancelled, 100 *lb.* of Paris, 100 *lb.* of Genoa, and 100 *lb.* of Leipſic, which is dividing them by 10; and to preſerve the equality on the ſide of the conſequents, cancel alſo the laſt ciphers in 150, 70, and 160; after which divide one of the remaining 10's on the antecedent ſide by 5, and the 15 on the conſequent-ſide by 5, and the quotients will be 2 on the ſide of the antecedents, and 3 on that of the conſequents: then 2 will meaſure 2 on the antecedent-ſide, and 16 on the conſequent-

ſide; as it will do 10 and 8, and the quotients thereafter will be 5 and 4; which being again repeated for the remaining 10 and 4 on both ſides, leaves another 5 on the antecedent-ſide, and 2 on the conſequent-ſide. And as there is no further room for abridging, by reaſon of the odd numbers 5 and 5 on the one ſide, and 7 and 3 on the other, the operation is made, and the anſwer found as above.

The uſe of this rule may be extended to all queſtions in proportion whatever, whether ſimple or compound, integral or fractional?

Exam. 2. If 12 yards of cloth coſt *L.* 10, 10 *s.* what will 20 yards coſt?

Ant.	Con.	Abridged.
12 yds.	*L.* 10.5	3 10.5
What will	20 yds coſt?	5

Then $\frac{10.5\times5}{3}$ = *L.* 17 10.

Exam. 3. If *L.* 100 in 12 months gain *L.* 5 intereſt, what will *L.* 500 gain in 6 months?

Ant.	Con.	Abridged.
L. 100 principal in 12 months.	*L.* 5 intereſt. 6 months.	2 5 5

What intereſt will 500 principal gain?

Then $\frac{5\times5}{2}$ = *L.* 12 10

Exam. 4. If 18 roods of ditching be done by 3 men in 16 days, when the day is 15 hours long, how much may be done by 8 men in 4 days, when the day is 9 hours long?

Ant.	Con.
3 men.	18 roods.
16 days.	4 days.
15 hours long.	9 hours long.

How many roods may 8 men do?

Each ſide being properly abridged, it will be

$$\frac{6\times3\times2}{5} = 7\frac{2}{5}$$

Exam.

Exam. 5. If 12 *cwt.* be carried 100 miles for 6 guineas, how many *cwt.* may be carried 150 miles for 12 guineas?

Ant.	Con.
First. 12 *cwt.*	6 guineas.
100 miles.	150 miles.

For 12 guineas how many *cwt.*?

Abridge both sides, and it will be $\frac{2\times2\times12}{3}=16$ *cwt.*

Exam. 6. If 12 men build a wall 30 feet long. 6 feet high, and 5 feet thick, when the day is 10 hours long, in how many days will 60 men build a wall 300 feet long, 8 feet high, and 6 feet thick, when the day is but eight hours long?

The terms being properly arranged and abridged, it will be $2\times30=60$.

Exam. 7. If 24 men dig a ditch 724 yards long, 7 feet deep. 3 feet broad at the bottom, and 5 feet broad at the top, in 236 days, when they work 13 hours and 24 minutes each day; in how many days will 16 men dig a ditch 975 yards long, 9 feet deep, 7 feet at the top, and 5 at the bottom, when they work 12 hours and 36 minutes every day?

The terms being properly arranged and abridged, it will be

$$\frac{3\times59\times201\times975}{2\times62\times181\times7}=1520 \text{ days.}$$

Exam. 8. If 18 men build a wall 40 feet long, 3 feet thick, and 16 feet high, in 12 days, how many men must be employed to build a wall 360 feet long, 8 feet thick, and 10 feet high, in 60 days?

The terms being properly aranged and abridged, it will be $2\times9\times3=54$ men. *Answer.*

All questions performed in this manner may be quickly proved by reversing the question: thus, If 54 men build a wall 360 feet long, 8 feet thick, and 10 feet high, in 60 days, how many men, *&c.*? The answer will be found to be 18.

CHAP. IV.

RULES OF PRACTICE.

THeſe compendiums in proportion, which are diſtinguiſhed by the name of the *rules of practice*, becauſe they were invented occaſionally by merchants in expediting practice, comprehend a great part of the calculations uſed in counting-houſes, particularly when an unit is the firſt term in the proportion; and it is certain, when any proceſs is ſhort and unperplexed, one is leſs liable to errour than when he hath to do with heavy multiplications and diviſions. In order to aſſiſt the young practitioner, I have inſerted a table of aliquot parts, and given the method of inventing it.

Table of the aliquot parts of a pound.

s.	*d.*	*L.*	*s.*	*d.*	*L.*
10	0	$\frac{1}{2}$	1	8	$\frac{1}{12}$
6	8	$\frac{1}{3}$	1	0	$\frac{1}{20}$
5	0	$\frac{1}{4}$	0	8	$\frac{1}{30}$
4	0	$\frac{1}{5}$	0	6	$\frac{1}{40}$
3	4	$\frac{1}{6}$	0	4	$\frac{1}{60}$
2	6	$\frac{1}{8}$	0	3	$\frac{1}{80}$
2	0	$\frac{1}{10}$	0	2	$\frac{1}{120}$

This table, and any other of the ſame kind, may be effected by reducing the given parts or denominations to the loweſt name mentioned in them for a diviſor, and an unit of the integer to the ſame name for a dividend, the quotient is the fractional part in the loweſt terms; for inſtance, 6 *s.* 8 *d.*=80 pence, and 1 *l.*=240 pence; but $\frac{240}{80}=3$, conſequently 6 *s.* 8*d.*=$\frac{1}{3}$ of 1 *l.* and ſo of any other.

Caſe 1. When the price of the integer is any aliquot part of a pound contained in the table, the anſwer is found by one ſingle diviſion.

Caſe 1. At 10 *s.* what coſt 375 yards?

2) 375

L. 187 10 for $\frac{1}{2}$ of 1 *l.* remaining = 10 s.

Exam.

Exam. 2. At 6 *s.* 8 *d.* what coſt 545 *lb.*?

3) 545

L. 181 13 4; here the remainder is 2×6 *s.* 8 *d.*

Exam. 3. At 5 *s.* what coſt 475 yards?

4) 475

L. 118 15; for $\frac{1}{4} = 15$ *s*

Exam. 4. At 4 *s.* what coſt 274 yards?

5) 274

L. 54 16; for $\frac{4}{5} = 16$ *s.*

Exam. 5. At 2 *s.* 6 *d.* what coſt 875 *lb.*?

8) 875

L. 109 7 6; for 3×2 *s.* 6 *d.* = 7 *s.* 6 *d.*

Exam. 6. At 2 *s.* what coſt 7425 yards?

10) 7425

L. 742 10; for 5×2 *s.* = 10 s.

Exam. 7. At 1 *s.* 8 *d.* what coſt 4167 yards?

12) 4167

L. 347 5; for 3×1 *s.* 8 *d.* = 5 *s.*

Exam. 8. At 6 *d.* what coſt 4578 yards?

4|0) 457|8

L. 114 9; for 18 ſixpences = 9 s.

Exam. 9. At 4 *d.* what coſt 975 yards?

60) 975

L. 16 5; for 15 fourpences = 5 *s.*

Exam. 10. At 3 *d.* what coſt 6875 yards?

8|0) 687|5

L. 85 18 $9\frac{3}{4}$; for $\frac{75}{4} = 18$ *s.* and the remaining 3×3=9 *d.*

Exam.

Exam. 11. At 2 *d.* what coſt 3745 ounces?

12|0) 374|5

L. 31 4 2; for $\frac{1}{6}$ = 4 *s.* 2 *d.*

Caſe 2. When the given price is any even part of a pound leſs than 2 *d* it will be an even part of ſome of thoſe mentioned in the table, and the anſwer is found by dividing and ſubdividing accordingly. The remainders may be valued as above, or carried on decimally.

Exam. 1. At 1 farthing what coſt 3600 yards?

12) 3600

80) 300 threepences; for 12 *qrs.* = 3 *d.*

L. 3 15 by the table.

Exam. 2. At $1\frac{1}{4}$ *d.* what 504 yards?

$1\frac{1}{4}$ *d.* = $\frac{1}{4}$ of 5 *d.* therefore 4) 504

6) 126 fivepences.

8) 21 half-crowns.

L. 2 12 6 by the table

Caſe 3. If the given price is no aliquot part of a pound, it will be compoſed of aliquot parts, which either may be divided for ſeverally as before, or, when the remaining part is any even part of the foregoing, divide the quotient for it, and the ſum of the quotients will give the anſwer. Sometimes we can, with great propriety, divide for the neareſt aliquot part above the given price, and when the value of the difference is ſubtracted from that quotient, the remainder will be the anſwer. A few examples will be the beſt illuſtration.

Exam. 1 At $2\frac{1}{2}$ *d.* what coſt 8754 *lbs.*?

120) 8754

$\frac{1}{2}$ *d.* is $\frac{1}{4}$ of 2 *d.* 4) 72 19 at 2 *d.*

18 4 9 at $\frac{1}{2}$ *d.*

L. 91 3 9

By

By dividing for the next even part, *viz.* 3 *d.*

80) 8754

6) 109 8 6 at 3 *d.* whereof $\frac{1}{2}=\frac{1}{8}$;
18 4 9 at $\frac{1}{8}$

L. 91 3 9 remains for anſwer.

Exam. 2. At $1\frac{1}{4}$ *d.* what coſt 574 ounces?

120) 574

8) 4 15 8 at 2 *d.* of which $\frac{1}{4}=\frac{2}{8}$.
11 11$\frac{1}{2}$ at 1 farthing to be deduced.

L. 4 3 8$\frac{1}{2}$ *Anſwer.*

Exam. 3. At $3\frac{1}{4}$ *d.* what coſt 3525 *lb.*?

80) 3525

$\frac{1}{4}$ *d.* is $\frac{1}{4}$ of 3 *d.* 4) 44 1 3 at 3 *d.*
11 0 3$\frac{1}{4}$ at $\frac{1}{4}$

L. 55 1 6$\frac{1}{4}$ value at $3\frac{1}{4}$ *d.*

Exam. 4. At $5\frac{1}{3}$ *d.* what coſt 4738 *lb.*?

5 *d.* is $\frac{1}{8}$ of 2 *s.* 6 *d.* 6) 4738

8) 789.6666 at 5 *d.* red. to half-crowns.

$\frac{1}{3}$ of 5 *d.* is 98.7083 at $\frac{1}{3}$ in half crowns.

8) 888.3749

111.0468=*L.* 111 0 11$\frac{1}{3}$

Exam. 5. At 7 *s.* 6 *d.* what coſt 5478 *lb.*?

4) 5478

2) 1369 10 for 5 *s.*
684 15 for 2 *s.* 6 *d.*

L. 2054 5 at 7 *s.* 6 *d.*

Exam.

Exam. 6. At 8 *s.* 9 *d.* what coſt 4785 yards?
5 *s.* = $\frac{1}{4}$ and 4 *s.* = $\frac{1}{5}$) 4785

957 = $\frac{1}{5}$
3 *d.* is $\frac{1}{16}$ of 5 *s.* 20) 1196 5 = $\frac{1}{4}$

2153 5 at 9 *s.*
59 16 3 at 3 *d.* to be deduced.

Remains *L.* 2893 8 9 at 8 *s.* 9 *d.*

Exam. 7. At 13 *s.* 8$\frac{1}{2}$ *d.* what coſt 475 yards?
10 *s.* = 2) 475

2 *s.* 6 *d.* = 4) 237 10
1 *s.* 3 *d.* = 2) 59 7 6
Deduce $\frac{1}{12}$ of 29 13 9

326 11 3
4 11$\frac{1}{4}$

L. 326 6 3$\frac{1}{4}$ *Anſwer.*

Exam. 8. At 15 *s.* 6 *d.* what coſt 4834 *lb.*?
2) 4834

2) 2417 at 10 *s.*
10) 1208 10 at 5 *s.*
120 17 at 6 *d.*

L. 3746 7 at 15 *s.* 6 *d.*

Note, At any price which is any even number of ſhillings, the value may be found by multiplying by the decimal of the price, and doubling the unit's place in the product for ſhillings.

Exam. 9. At 14 *s.* what coſt 475?
475
·7

L. 332 10 *Anſwer.*
2

Exam.

Exam. 10. At 6 *s.* 6¼ *d.* what coſt 494?

494
·3

12	148	4		at 6 *s.*
8	12	7		at 6 *d.*
	1	10	10¾	at ¼

L. 162 1 10¾ at 6 *s.* 6¼ *d.*

Exam. 11. At 18 *s.* 9 *d.* what coſt 478?

40) 478
·9

2	430	4		at 18 *s.*
	11	19		at 6 *d.*
	5	19	6	at 3 *d.*

L. 448 2 6 at 18 *s.* 9 *d.*

Caſe 4. If pounds are mentioned in the price, multiply for them; and if there are parts included in the quantity, reduce them to decimals, or take parts of the given price for them.

Exam. 1. At 2 *l.* 2¼ *d.* what coſt 325¼ *cwt.*?

120) 325.25
2

8	650.50	at 2 *l.*
	2.710416	at 2 *d.*
	.338802	at ¼ *d.*

L. 653.549218

Valued 653 10 11¼ *Anſwer.*

Exam. 2. If a dividend of 1 *l.* 13 *s.* 3 *d.* is made upon 1 *l.* of the ſtocks of a ſeparating company, what will 526 *l.* 10 *s.* amount to?

2	526.5	= 1	
4	263.25	= 0	10. 0
5	65.8125	= 0	2 6
2	13.1625	= 0	0 6
	6.58125	= 0	0 3
L	875.30625	*L.* 1	13 3

Exam. 3. 96 tuns, 18 C. 2 qrs. 24 lb. at *L.* 6, 15 *s.* *per* tun?

96.93571
6

8) 581.61426 = *L.* 6
72.70178 = 15 *s.* = $\frac{3}{4}$ of *L.* 6

654.31604 = *L.* 654 6 $3\frac{1}{4}$

Exam. 4. 47 *oz.* 14 *pwt.* 18 *gr.* at 3 *l.* 15 *s.* 5 *d.*?

2) 47.7375
3

	143.2125	= *L.*	3	0 0
2	23.8687	=	0	10 0
12	11.9343	=	0	5 0
	.9945	=	0	0 5
	180.0100	= *L.*	3	15 5

Exam. 5. 54 *oz.* 9 *pwt.* 14 *gr.* at 3 *l.* 18 *s.* $7\frac{1}{2}$ *d.*?

54.47916
3

5	163.43748	for *L.*	3	0 0
2	32.68749	for	0	12 0
12	16.34374	for	0	6 0
4	1.36197	for	0	0 6
	.34049	for	0	0 $1\frac{1}{2}$
	214.17117	for *L.*	3	18 $7\frac{1}{2}$

Exam. 6. 16 tun. 3 hhds. 53 gal. at 28 *l.* 7 *s.* 2 *d.*?

3) 16.960317
28

135.682536
339.20634
5.6534 for 6 *s.* 8 *d.*
.424 for 6 *d.*

480.9663 *Answer.*

Case 5. When there is a fraction in the given price, it may be entirely avoided in the computation, by multiplying the given

given price, and dividing the given quantity by the denominator of the fraction.

Exam. 1. Required the coſt of 1000 yards ſailcloth at $9\frac{7}{8}d.$ *per* yard.

8) 1000

125

Therefore 125 at 6 *s.* 7 *d.*

·3

37 10 at 6 *s.*
3 2 6 at 6 *d.*
10 5 at 1 *d.*

41 2 11 at 6 *s.* 7 *d.*

$9\frac{7}{8}$

79 *d.* = 6 *s.* 7 *d.*

For 1000 at $9\frac{7}{8}$

25 at 6 *d*
12 10 at 3 *d.*
3 2 6 at $\frac{1}{4}$ or $\frac{2}{8}$.
10 5 at $\frac{1}{2}$ or $\frac{1}{8}$ of $\frac{5}{8}$.

41 2 11

Hence it is obvious that 125 yards at 6 *s.* 7 *d.* will coſt juſt as much money as 1000 yards at $9\frac{7}{8}$ *d.* and the ſame kind of reaſon will hold good in every other inſtance.

Exam. 2. Required the value of 1260 yards of incle at 1 *d. per* yard?

12) 1260

105

5 5 for 1 *s.*
1 15 for 4 *d.*
8 9 for 1 *d.*

7 8 9

$1\frac{5}{12}$

1 *s.* 5 *d.*

Exam. 3. At 5 *s.* $11\frac{9}{16}$ *d.* what coſt 4578 yards?

5 $11\frac{9}{16}$

L. 4 15 5

16) 4578

286.125

4

1144.500 at *L.* 4 0 0
143.0625 at 0 10 0
71.53125 at 0 5 0
5.9601 at 0 0 5

1365.05385

In the preceding caſes there will be found a ſufficient number of examples for ſhowing the method of ſolving any queſtion

ſtion in the rule of proportion, when unity is one of the firſt terms, with the greateſt expedition poſſible, that can be communicated in this way. At the ſame time I would recommend to the young arithmetician, to go over all theſe caſes and examples again and again, till he not only be well acquainted with the method, but be able to do any of the examples quickly: nor content with that, he ought, and will find it to his account, to invent many more to himſelf, try them in different ways, to prove one another, and thereby be enabled to calculate invoices, bills of parcels, *&c.* for which theſe rules are particularly adapted, and which make up a great part of the buſineſs of computation in the cou...ng-room, as hath been formerly obſerved.

Specimen of a Bill of Parcels.

Mr. Thomas Johnſton, bought of Glen and Peters,

	L.	s.	d.	L.	s.	d.
5 pieces of Scotch linen, 125 yards 3 *s.* $2\frac{1}{2}$ *d.*	20	11	$5\frac{1}{2}$			
25 Iriſh ditto, 625 yds. 1 *s.* $9\frac{1}{6}$ *d.*	55	13	$3\frac{1}{3}$			
14 dozen hats. 7 *l.* 15 *s.* 6 *d.* - -	108	17	0			
37 pieces broad cloth, 555 yds. 14 *s.* $3\frac{1}{2}$ *d.*	396	11	$10\frac{1}{2}$			
48 pieces of lawns, 480 yds. 2 *s.* $7\frac{1}{8}$ *d.*	63	5	0			
37 pieces of cheques, 740 yds. $9\frac{7}{8}$ *d.*	30	8	$11\frac{1}{2}$			
				675	7	$6\frac{1}{2}$

Specimen of an Invoice.

Invoice of ſundries, ſhipped on board the Sailfiſh, Capt. Paton maſter, bound for St. Kitts, conſigned to David Macfarlane merchant in Baſſeterre, to ſell for my account, as under, *viz.*

		L.	s.	d.	L.	s.	d.
D. M.	160 pieces cheques, 4000 yds. 1 *s.* $2\frac{1}{2}$ *d.* - -	245	16	8			
Bales.	9 ditto Fife linen, 2751 yds. 1 *s.* $7\frac{5}{8}$ *d.* - -	224	19	$0\frac{1}{4}$			
	80 Iriſh ditto, 2000 yds. 1 *s.* $6\frac{7}{8}$ *d.*	157	5	10			
1.	100 ditto gauzes, 1900 yds. 3 *s.* $1\frac{3}{4}$ *d.* - - -	157	5	10	785	7	$4\frac{1}{4}$
	350 razors, 1 *s.* $3\frac{3}{4}$ *d.* -	22	19	$4\frac{1}{2}$			
	420 penknives, $9\frac{1}{2}$ *d.*—90 ditto, $5\frac{3}{4}$ *d.*—40 ditto, $10\frac{1}{8}$ *d.*	20	11	$0\frac{1}{2}$			
2.	1000 pair of ſciſſars, $2\frac{5}{8}$ *d.*—500 ditto, $3\frac{3}{4}$ *d.*—230 ditto, $4\frac{1}{4}$ *d*	22	5	$2\frac{1}{2}$			
	150 ſets of buckles, 1 *s.* $2\frac{1}{8}$ *d.*—100 d°, $10\frac{3}{4}$ *d.*—50 d°, $8\frac{1}{8}$ *d.*	15	1	$6\frac{3}{8}$	80	17	2
	500 pair mens ſhoes, 2 *s.* $9\frac{1}{4}$ *d.*	70	6	3			
	500 ditto pumps, 3 *s.* $1\frac{1}{4}$ *d.*	77	12	1			
3.	500 ditto womens, 3 *s.* $7\frac{1}{4}$ *d.*	90	2	1			
	500 ditto boxes, 2 *s.* $7\frac{1}{8}$ *d.*	64	16	$10\frac{1}{2}$			
					302	17	$3\frac{1}{2}$
		1169	1	$9\frac{1}{2}$	=1169	1	$9\frac{1}{2}$

VARIETIES IN PROPORTION.

INTRODUCTION.

SO extenſive and various is the buſineſs of the counting-houſe, that it would be impoſſible, with any degree of propriety, to croud it altogether into one general head: and therefore, to render the computations relative to the merchant, the banker, the inſurer, the ſtockjobber, the cuſtom-houſe, *&c.* as practical and intelligible as poſſible, to each ſpecies or computation I have aſſigned a particular variey, in which the method of calculation is illuſtrated with proper examples; the nature of the tranſactions, which give riſe to theſe computations, explained; the laws and regulations which regard the more critical parts of the mercantile buſineſs, pointed out; with every thing elſe that may ſerve to eluçidate the different ſubjects that compoſe theſe varieties.

Var. 1. TARE and TRETT.

BY Tare and Trett, may be underſtood, any defect, waſte, or diminution in the weight, quantity, or quality of goods, by reaſon of certain circumſtances, for which a certain abatement is to be made by the ſeller to the buyer, and is different, in different merchandiſes, and in different countries. To have a more particular idea of the uſe and deſign of this variety, it will be proper to conſider, that,

In weighing ſeveral commodities, the weight of the package is included in the invoice-weight of the goods, and the whole, upon that account, called *groſs weight*; the allowance for which is regulated either by cuſtom, or ſome expreſs ſtipulation betwixt the buyer and ſeller, and goes under the following denominations.

1. *Tare*, which is an allowance for the weight of the caſk, cheſt, box, *&c.* in which the goods are packed, and allowed to be either ſo much *per* bag, barrel, cheſt, *&c.* at ſo much *per cwt.* or at ſo much of the groſs weight, called *invoice tare.*

2. *Trett*, which is an allowance of 4 lb. *per* 104 lb. for duſt contracted by keeping, waſte, by freight, carriage, *&c.*

When a deduction is made for the allowance of tare from the groſs weight, the remainder is called *nett*, unleſs trett

is

is likewiſe allowed, when it is called *ſuttle*; and in that caſe the nett does not appear till $\frac{4}{104}$ or $\frac{1}{26}$ be ſubtracted from the ſuttle, and then the remainder gives the nett.

Theſe allowances may be taken off the groſs by ſeveral methods; but, as it is no part of our deſign to dwell upon tedious ones, we ſhall illuſtrate the rule only by ſuch as ſeem moſt convenient for diſpatch.

Caſe 1. When the allowance is at ſo much *per* bag, barrel, cheſt, *&c.* the anſwer or nett is found by multiplication and ſubtraction, as in the following examples.

Queſt. 1. What is the nett weight of 40 hhds. of tobacco, weighing groſs 210 cwt. 3 qrs. tare 70 lb. *per* hhd. ?

lb.	*qrs.*	*lb.*	*hhds.*		
70 = 2		14 × 40 =		25	tare to be deducted.
				185	3 nett weight.

Queſt. 2. What is the nett weight of 4 hhds. tobacco, weighing groſs 16 cwt. 8 lb. tare 85 lb. *per* hhd. ?

lb.	*cwt.*	*lb.*	
	16	8	groſs.
85 × 4 =	3	4	tare to be deducted.
	13	4	nett.

Caſe 2. When the allowance is at ſo much *per* cwt. the beſt way of finding the tare, is in general by aliquot parts; though ſometimes the nett may readily be found by making 112 lb. the firſt term in a direct proportion, the difference betwixt the given tare and 112 the ſecond, the given groſs the third; the fourth proportional will be the nett, without any ſubtraction.

TABLE of ALIQUOT PARTS.

lb.	*cwt.*	*lb.*	*half cwt.*	*lb.*	*qr.*	*qrs.*	*cwt.*
16 =	$\frac{1}{7}$	8 =	$\frac{1}{7}$	7 =	$\frac{1}{4}$	2 =	$\frac{1}{2}$
14 =	$\frac{1}{8}$	7 =	$\frac{2}{8}$	4 =	$\frac{1}{7}$	3 =	$\frac{1}{4}+\frac{1}{2}$ of $\frac{1}{2}$.
						&c.	

Queſt.

Queſt. 1. What is the nett weight of 256 cwt. 2 qrs. 19 lb. tare 14 *lb. per* cwt.

lb. 256.669 groſs.
14. = $\frac{1}{8}$ = 32.083 tare to be deducted.

224.586 nett 224 cwt. 2 qrs. 9 *lb. Anſwer.*

Or thus,

lb. *lb.* *lb.*
112 : 112—14 :: 256.669 : 224.586 as before.

Queſt. 2. What is the nett of 410 cwt. 2 qrs. 12 lb. at 20 lb. *per* cwt.?

410 2 12 groſs.

lb.
16 = $\frac{1}{7}$ = 58 2 17$\frac{1}{4}$
4 = $\frac{1}{4}$ of $\frac{1}{7}$ = 14 2 18$\frac{1}{4}$
20 = 73 1 8 tare to be deducted.

337 1 4

lb. *lb.* *lb.* *cwt. groſs* *cwt. nett.*
or 112 : 112—20 :: 410 2 12 : 337 1 4

Queſt. 3. What is the nett weight of 384 cwt. 3 qrs. 24 lb. tare 17 *per* cwt.?

cwt. qrs. lb.
384 3 24

lb.
14 = $\frac{1}{8}$ = 48 0 13$\frac{1}{2}$
2 = $\frac{1}{7}$ of $\frac{1}{8}$ = 6 3 14 } added.
1 = $\frac{1}{2}$ of $\frac{1}{7}$ of $\frac{1}{8}$ = 3 1 21 }
17 = 58 1 20$\frac{1}{2}$ tare to be deducted.

326 2 3$\frac{1}{2}$ nett.

Note, In caſes of this kind the moſt minute exactneſs is not required; for merchants, inſtead of ſubdividing the lbs. for the tare, take the neareſt quarter of a lb. as in the laſt example, for ſufficient exactneſs.

Queſt. 4. At 10 lb. *per* cwt. tare, what is the nett of 410 cwt. 2 qrs. 12 lb. groſs?

cwt. qrs. lb.
2) 410 2 12 groſs.

205 1 6 reduced to half cwts. of which 8 lb. $=\frac{1}{14}$, and $2\times7=14$.

lb.
$8=\frac{1}{7}=$ 29 1 9
$2=\frac{1}{4}$ of $\frac{1}{7}=$ 7 1 9

36 2 18 tare to be deducted.

373 3 22 nett.

Caſe 3. When tare and trett are both to be allowed, find and divide the tare as in the laſt caſe, the remainder will be the ſuttle, $\frac{1}{26}$ of which is always the trett; and when that is taken from the ſuttle, the remainder is the nett weight.

Queſt. 1. What is the nett of 375 cwt. 1 qr. 15 lb. tare 13 lb. *per* cwt. trett 4 *per* 104?

2) 375 1 15 groſs.

187 2 21½ reduced to half-cwts. of which,

lb.
$8=\frac{1}{7}=$ 26 3 7
$4=\frac{1}{2}$ of $\frac{1}{7}=$ 13 1 18
$1=\frac{1}{4}$ of $\frac{1}{2}$ of $\frac{1}{7}=$ 3 1 11
} add.

43 2 8 tare to be deducted.

26) 331 3 7 ſuttle.
12 3 1 trett.

319 0 6 nett.

Queſt. 2. In 732 cwt. 1 qr. 21 lb. groſs packed in 57 butts, tare 19 lb. *per* butt, and trett 4 *per* 104 lb. how many cwt. nett?

Butts. *lb.* 732.4375 groſs.
57 × 19 = 9.67 tare to be deducted.

$\frac{1}{26}$722.7675 ſuttle.
27.798 trett to be deducted.

694.9695=694 cwt. 3 qrs. 24 lb. nett.

The

The operations in this rule are ſo extremely eaſy, that more examples would be unneceſſary.

Variety II. COMPUTATION of CUSTOMS, BOUNTIES, &c.

CUſtoms are certain duties or tolls, impoſed by the ſovereign, or legiſlative power of the nation, on certain imports and exports, for the maintainance and ſupport of government, receivable at the cuſtomhouſe, and regulated by tariffs, or books of rates; the principal whereof may be reckoned tonnage, poundage, old ſubſidy, new ſubſidy, $\frac{1}{2}$, $\frac{3}{4}$ ſubſidy, &c.

Bounties are certain premiums allowed for the exportation of certain Britiſh manufactures.

Drawbacks are certain duties, either of the cuſtoms, or of the exciſe, for Britiſh manufactures that have paid duty to the exciſe, or certain foreign merchandiſes, that have paid duty at importation.

In ſo ſmall a ſpace as can be allotted here for the article of cuſtoms, it is not to be ſuppoſed, that I can exhibit a book of rates, or inſtance the ſeveral acts of parliament, by which the ſeveral rates have been impoſed, renewed, or confirmed. To be well acquainted with theſe, we muſt have recourſe to the acts themſelves, and in place thereof to Crouch or Saxby. My buſineſs ſhall be to ſhow the method of computation, and the uſe to be made of a book of rates.

EXAMPLES.

1. Suppoſe it was required to compute the duty on 1200 lb. of Britiſh plantation tobacco from the book of rates by Saxby.

Under the letter T, in the table (page 244), and oppoſite to Tobacco of St Chriſtopher's, Barbadoes, or any of the Caribbee iſlands, Virginia, &c. we find it rated at 1 *s.* 8 *d. per* lb. and upon this rate the computation of the duties is made. The marginal or referring letters to this ſpecies are B a, M b, which by the explanatory table (page 74.) we find point to the N° 1. III. 2. 3. 5. 8. Hence the computation will ſtand as follows.

Rate of 1200 lb. at 1 *s.* 8 *d.*=*L.* 100

5 *per cent.*=$\frac{5}{100}$ or $\frac{1}{20}$ of the rate =	5	0	groſs old ſubſidy.
Diſct at 25 *per cent.*=$\frac{1}{4}$ to be deducted,	1	5	if paid down.
No 1. page 10.	3	15	nett ſub. to be paid.
III. page 15. rate and diſct as before,	3	15	nett addit. duty.
2. page 20. rate and diſct as before,	3	15	nett new ſubſidy.
3. page 22. $\frac{1}{7}$ rate and diſct as before,	1	5	nett $\frac{1}{7}$ ſubſidy.
5. page 23. rate and diſct as before,	3	15	nett ſubſidy.
8. page 29. rate 15 *per cent.* diſc. 25	11	5	nett impoſt.
Total duty,	27	10	to be paid down.

ILLUSTRATION.

The groſs old ſubſidy is found by taking $\frac{1}{20}$ of the rate, the diſcount by taking $\frac{1}{4}$ of that; additional duty and new ſubſidy are the ſame with the old ſubſidy, and $\frac{1}{7}$ ſubſidy is made out by taking $\frac{1}{7}$ of any of the above; ſubſidy is the ſame with any of the three firſt-mentioned articles, and impoſt is effected by multiplying ſubſidy by 3. There was another ſubſidy added *anno* 1759, which is not mentioned in any edition of Crouch or Saxby that I have ſeen, and is the ſame with nett ſubſidy; therefore to the laſt found duty *L.* 27 - 10

add ſub. 1759 3 - 15

Total duty 31 - 5

When the old ſubſidy is only paid ready money, and the other branches bonded, the computation will be as follows.

Lb. tobacco 50000

Rate at 1 *s.* 8 *d.*	*L.*	4166	13	4
$\frac{1}{20}$ for 5 *per cent.*		208	6	8
25 *per cent.* for $\frac{1}{4}$ of the groſs,		52	1	8
		156	5	0 nett old ſubſidy.
$\frac{1}{20}$ of the groſs		20	16	8
		177	1	8 additional duty.
		177	1	8 new ſubſidy.
Carried forward		354	3	4

Brought

Brought forward	354	3	4
	59	0	$6\frac{1}{4}\frac{1}{3}$ ſubſidy.
	531	5	0 impoſt.
	177	1	8 ſubſidy $174\frac{7}{8}$
	177	1	8 ſubſidy 1759
	1298	12	$2\frac{1}{4}$ duties bonded.
	156	5	0 paid on importation.
	1454	17	$2\frac{3}{4}$ total duties.

The duties on tobacco, or any other goods imported, may very readily be calculated by analogy thus; for 5000 lb. of tobacco.

lbs. *duties ſecured.* *lb.*

50000 : *L.* 1298 12 $2\frac{3}{4}$ :: 5000

Cancel 3 ciphers on each ſide, and abridge the remaining figures by 5, and it will be,

10) 1298 12 $2\frac{3}{4}$

129 17 $2\frac{11}{40}$ ſecured.

and 10) 156 5

15 12 6 paid down.

145 9 $8\frac{11}{40}$ total duties.

Or by having the duties on 1 lb. ready computed in a pocket book, the duties on any number of lbs. may be readily found by practice.

Suppoſing the whole duties paid down.

	s.	*d.*
Rate of 1 lb.	1	8
5 *per cent.* of that	1	

Diſcount	$\frac{1}{4}$
No I. - -	$\frac{3}{4}$
III. - -	$\frac{3}{4}$
2 - -	$\frac{3}{4}$
3 - -	$\frac{1}{4}$
5 - -	$\frac{3}{4}$
8 - 2	$\frac{1}{4}$
Sub. 1759 - -	$\frac{3}{4}$
Total	$6\frac{1}{4}$

d.

(Decimally

No I. - -	.75
III. - -	.75
2 - -	.75
3 - -	.25
5 - -	.75
8 - 2	.25
Sub. 1759 - -	.75
	6.25

Hence to compute the duties paid down on 1200 lb.

60) 1206

20	for 4	*d.*
10	for 2	*d.*
1 5	for $\frac{1}{4}$.	
31 5	total as above.	

Calculations of this kind may be checked as in the following

EXAMPLE.

436 hhds. of tobacco, *per* the Argyle, Alexander Morison master, from Virginia, containing 283.400 lb. tobacco of the British plantation.

d

20) 283 400 lb. at $6\frac{4}{20}$ and $\frac{3}{5}$ of $\frac{1}{20}$

3) 14.170

2)	4723	6	8
20)	2361	13	4
3)	118	1	8
	39	7	$2\frac{1}{4}$
	7242	8	$10\frac{3}{4}$
	1003	14	2
	8246	3	$0\frac{1}{4}$

Nett old sub. *L.* 885 12 6 paid down.

Addit. duty,	1003 14 2
New subsidy,	1003 14 2
$\frac{1}{3}$ sub.	334 11 $4\frac{3}{4}$
Impost on tobacco,	3011 2 6
Subsidy $174\frac{7}{8}$	1003 14 2
Ditto 1759	1003 14 2
	7360 10 $6\frac{1}{4}$ secured.
	8246 3 $0\frac{1}{4}$ total duties.

Brown and Muscovado sugars of the British plantations are rated

rated at *L.* 1, 10 *s. per* cwt. the 5 *per cent.* of which is the ſubſidy groſs, the 5 *per cent.* of which groſs is the old ſubſidy nett: the new ſubſidy is the ſame, $\frac{1}{3}$ ſubſidy is $\frac{1}{3}$ of the new ſubſidy, and ſubſidies $17\frac{7}{8}$ and 1759 the ſame with the groſs. Hence, the duties on 200 cwt. Muſcovado ſugar of the Britiſh plantation, will be computed as under.

	cwt.	
	200 at *L.* 1-10 *s.*	
	100	
Rate	300	
Sub. groſs,	15	
5 *per cent.*	0	15
N. ſ.	14	5
O. ſ.	14	5
$\frac{1}{3}$ ſ.	4	15
S. $17\frac{7}{8}$	15	0
Do 1759	15	0
Total duties	63	5

Proof.

4) 200 cwt. at 6 *s.* $3\frac{1}{10}$ *d.*

5) 50

4) 10

4) 2 10

5) 12 6

2 6

63 5 0 as before.

Hence 63 5 *s.* *d.* $= .6\ 3\frac{1}{10}$

200

Computation of the duties on 4 puncheons, containing 400 gallons rum from Jamaica, of the Britiſh plantation.

	L.	*s.*	*d.*
1ſt, 490 gallons rated at 1 *s.* 8 *d. per* gallon,	33	6	8
5 *per cent.* of the rate,	1	13	4
5 *per cent.* diſcount,	0	1	8
Old ſubſidy nett,	1	11	8
			3
Subſidies on ſpirits,	4	15	0
Coinage ditto,	1	11	9
Subſidy $17\frac{7}{8}$ = the groſs	1	13	4
Cuſtoms,	8	0	1

to be paid down.

To

To the cuſtoms formerly found, L. 8 0 1
Add the exciſe at 4 *s.* 8 *d. per* gallon, 93 6 8 bonded.

and the total duties will be 101 6 9

For a proof, the duties on 400 gallons may be computed as under.

Groſs ſubſidies at 3*d.*	L.	5	0 0
Of diſcount at 5 *per cent.*		0	5 0
Subſidies on ſpirits,		4	15 0
Coinage on ditto,		1	11 9
Sub. $174\frac{7}{8}=\frac{1}{7}$ of the groſs,		1	13 4
		8	0 1
Exciſe at 4 *s.* 8 *d. per* gallon,		93	6 8
Total duties,	L.	101	6 9 as before.

Hence the duties on rum per gallon will be

$$\frac{101\ 6\ 9}{400} = L.\ 0\ 5\ 0\frac{321}{400}$$

But the rates of rum vary according to the proof.

Merchants check or prove the computations made in the cuſtom-houſe, by computing the duties practically according to the rate *per* lb. cwt. yard, *&c.* as in the following

EXAMPLES.

1. What is the nett duty on 12453 lbs. of tobacco, rate $6\frac{4}{20}$ *d.* and $\frac{2}{3}$ of $\frac{1}{20}$ *per* lb.?

$6\frac{4}{20}$ and $\frac{2}{3}$

s.

1 6 $\frac{14}{20}$

3) 12453

20) 4151

2)	107	11		for 1 *s.*
12)	53	15	6	for 6 *d.*
5)	4	9	$7\frac{1}{2}$	for $\frac{1}{20}$
		17	11	for $\frac{2}{20}$
		17	11	for $\frac{2}{20}$

L. 167 11 $11\frac{1}{2}$ *Anſwer.*

2. What

2. What is the duty of 780 cwt. Muſcavado ſugar at 6 *s.* $3\frac{18}{20}$ *d. per* cwt.?

s.	
6 $3\frac{18}{20}$	6) 780
L. 6 6 6	130
	6
	20) 780 for *L.* 6 0 0
	39 for 0 6 0
	3 5 for 0 0 6
	L. 822 5

Bounties are calculated, with the greateſt eaſe, by practice. For inſtance, ſuppoſe it was required to calculate the bounty on 5000 yards of ſail cloth exported, at 2 *d. per* yard.

12|0) 5000

41 13 4 *Anſwer.*

400 barrels of ſalmon, at 4 *s*, 6 *d. per* barrel.

5) 400

8) 80

10

L. 90 *Anſwer.*

7650 yards of Fife linen. at 9*d. per* yard, bounty $1\frac{1}{2}$ *d.*

2) 7650

8|0) 382|5

47 16 3 *Anſwer.*

Drawbacks are computed as the duties, in ſome goods the whole being allowed, and in others only a part, which is ſpecified in the book of rates.

VARIETY

VARIETY III.

RULE OF MIXTURES.

IN groceries they ſometimes mix ſeveral ſorts of their wares together, for the convenience of ſale; and to proportion the price of the mixture to the ſeveral prices of the ſimples, or to find the quantity of each ingredient, which will proportion the mixture to a certain price, will admit of the following caſes.

Caſe 1. When the quantity of each ingredient is the ſame, the ſeveral rates *per* lb. oz. cwt. *&c.* added together, and their ſum divided by the number of quantities, will give the rate of the mixture.

Example. A grocer would mix ſugar at 50 s. *per* cwt. at 60 *s.* *per* cwt, and at 70 *s.* *per* cwt; what is 1 cwt of the mixture worth?

50
60
70
3) 180
60 *s.* *Anſwer.*

Caſe 2. When the quantities as well as the prices are different, find the ſeveral values according to the different rates and quantities, and divide the ſum of their values by the ſum of the quantities; the quotient gives the anſwer.

Exam. 1. A grocer bought 275 lb. of almonds at $5\frac{1}{2}$ *d.* *per* lb. and 295 lb. of raiſins at $3\frac{3}{4}$ *d.* *per* lb. which he mixed together; what is 1 lb. of the mixture worth?

2 275 lb.

275 lb. of almonds 295 lb. of raisins at $3\frac{1}{4}d.$

5	3
8) 1375 at $5d.$	4) 885 at $3d.$
$171\frac{7}{8}$ at $\frac{5}{8}d.$	$221\frac{1}{4}$ at $\frac{3}{4}d.$
Almonds $1546\frac{7}{8}$ at $5\frac{5}{8}d.$	$1106\frac{1}{4}$ at $3\frac{1}{4}d.$
Raisins $1106\frac{1}{4}$	

$275+295=570$) $2653\frac{1}{8}$ ($4\frac{5}{8}d.$ nearly.
2280

373
8

2985
2850

135

Exam. 2. If 278 gallons of rum at 11 *s.* 6 *d. per* gallon were mixed with 174 gallons at 9 *s.* 3 *d. per* gallon, what would a gallon of the mixture be worth?

278	174
$11\frac{1}{2}$	$9\frac{1}{2}$
3058	1566
139	$43\frac{1}{2}$
3197	$1609\frac{1}{2}$
$1609\frac{1}{2}$	

$278+174=452$) $4806\frac{1}{2}$ (10 *s.* $7\frac{1}{2}d.$
452

286
12

3438
3164

274
4

1096
904

(192)

Exam. 3. A grocer hath 75 lb. of confections, which he can ſell at 1 *s.* 6¼ *d.* 96 lb. of another kind, which he can ſell at 1 *s.* 4½ *d.* and 68 lb. of another kind, which he can ſell at 1 *s.* 3 *d.*; what is 1 lb. of the mixture worth?

75 *lb.* at 1 *s.*=75 0
at 0 *d.*=37 6
at ¼ *d.*= 4 8½
75 *lb.* at 1 *s.* 0¼ *d.*= ——117 2¾
96 *lb.* at 1 *s.*=96
at 4 *d.*=32
at ½ *d.*= 4
96 *lb.* at 1 *s.* 4½ *d.*= ——132
68 *lb.* at 1 *s.*=68
at 3 *d.*=17
68 *lb.* at 1 *s.* 3 *d.*= —— 85

239 - - - -) 334-2¾ (1-4¼ *Anſwer.*
239
95
12
1142
956
186
4
745
717
(28)

Exam. 4. A goldſmith or refiner hath 12 oz. of gold at 4 *l.* *per* oz. 8 oz. at 4 *l.* 5 *s.* *per* oz. 3 oz. at 4 *l.* 6 *s.* 8 *d.* *per* oz. and 9 oz. at 4 *l.* 13 *s.* 4 *d.* *per* oz.; if theſe were all melted down together, what would an ounce of the compoſition be worth?

12×4	0	0	= L.	48
8×4	5	0	=	34
3×4	6	8	=	13
9×4	13	4	=	42
—			8)	137
32				
			4)	17-2-6

L. 4 5-7½ *Answer.*

Case 3. To increaſe or diminiſh a compound proportionally, by knowing the ſeveral quantities of the ſimples in the compoſition.

RULE.

As the ſum of the particular quantities of the compound given is to the whole quantity propoſed to be increaſed or diminiſhed, ſo is each particular quantity in the given compound, to the due proportion required of that ſpecie, fineneſs, *&c.*

Example. Let the compound in the laſt queſtion be increaſed to 48 oz. how much muſt be taken of each ſimple ingredient?

32	:	48	::	12	:	18	at L.	4 0 0
32	:	48	::	8	:	12	at	4 5 0
32	:	48	::	3	:	4½	at	4 6 8
32	:	48	::	9	:	13½	at	4 13 4

48

Case 4. Having the ſimples of any compound given, to find how much of any ſimple ingredient is in any part of that compoſition.

RULE.

As the total of the compoſition is to the quantity of any ſimple in that compoſition, ſo is the total quantity propoſed to be proportionally compounded, to the quantity of each ſimple to be in that propoſed quantity.

Example. It is required to find out how much of each ingredient is in a pound weight of gold, or 12 ounces, at the prices mentioned in the laſt example, when there are 32 ounces in the compoſition.

32	:	12 or 8	:	3	::	12	:	4½ at L. 4 0 0
		8	:	3	::	8	:	3 at 4 5 0
		8	:	3	::	3	:	1⅛ at 4 6 8
		8	:	3	::	9	:	3⅜ at 4 13 4

12

Caſe 5. The total of the compound of two ſimples, with the total value of that compoſition, and the value of an unit of each ſimple being given, to find the quantity of each ſimple ingredient in the compoſition.

R U L E.

Multiply the total quantity of the compoſition by the leſſer price of the unit, deduct the product from the total value of the compoſition, and divide the remainder by the difference in value of an unit of the two ſimples given, and the quotient is the quantity of the higher priced ſimple, whoſe complement to the total of the compound gives the other quantity.

Example. Suppoſe there are 20 ounces of gold melted into one maſs, conſiſting of gold at 4 *l. per* oz. and gold at *L.* 4, 5 *s. per* oz. the value of the whole being 82 *l.*; it is required to find how much of each was taken to make the compoſition?

oz.	
20 =	*L.* 82
4 =	1 oz. of the leſſer price.
80	
82	

Diff. of a unit 5 *s.* = .25) 2 the difference

	L.	
8 oz. of the higher price =	34	82
20 the whole compoſition =		
Diff. 12 oz. of the lower price =	48	

DEMONSTRATION.

Let T repreſent the total quantity of the mixture here, 20 oz. of gold, and let V repreſent the total value of the ſaid mixture = 82 *l.*; let P = 4 *l.* 5 *s.* the price of an unit of the deareſt ſimple, and *p* = the price of an unit of the cheapeſt ſimple; *a* = the quantity of the firſt, *e* = the quantity of the ſecond. Then *a*+*e* = T *per* queſtion, and *e* = T − *a*; by multiplying each quantity by the reſpective price of an unit, it will be *a*P = the value of the deareſt part of the compoſition, and T*p* − *ap* = the value of the cheapeſt part; and conſequently the ſum of both *a*P + T*p* − *ap* = V the total value: and by ſubtracting

ſubtracting Tp, it will be $aP-ap=V-Tp$; and dividing both ſides by the coefficients of a, we find $a=\frac{V-Tp}{P-p}$. *Q. E. D.*

Caſe 6. The particular rates of the ſeveral ſimples to be mixed, and the rate of the mixtures given, to find how much of each ingredient muſt be taken to compoſe the mixture.

RULE.

Write down the different rates, the higheſt uppermoſt, the next higher below that, and the reſt in the ſame order; couple the various rates thus ranked, one with another, in ſuch a manner, as the one may be greater and the other leſs than the mean rate; then take the difference betwixt each of the rates and the mean, and write it down over againſt that with which it was linked; laſtly, ſum up all the differences, and their total will be the ſum of the mixtures, at the given rate, and the ſeveral differences will aſcertain the quantity of each ingredient to be taken in compounding the mixture, according to the method in which the ingredients are alligated.

Example. A vintner hath rum which he values as follows: Some at 18*s.* ſome at 16*s.* ſome at 14*s.* and ſome at 13*s.* *per* gallon; but as the higheſt priced was ſeldom called for, and the loweſt complained of, he propoſes to make a mixture out of the whole, which will ſtand him 15*s.* *per* gallon, how many gallons of each muſt he take to anſwer his purpoſe?

15	18	2	or	18	1
	16	1		16	2
	14	1		14	3
	13	3		13	1
		7			7

By either of theſe methods he will obtain his purpoſe.

For 2 *gall.*	at 18*s.*	= 36*s.*	and	1 *gall.*	at 18*s.*	= 18
1	at 16	= 16		2	at 16	= 32
1	at 14	= 14		3	at 14	= 42
3	at 13	= 39		1	at 13	= 13
7	at 15	= 105		7	at 15	= 105

The truth of this manner of operation may be accounted for thus.

Suppoſe a mixture only of two ſimples, the price of the one

one at 4 *d.* and the price of the other at 8 *d.* which when mixed may be ſold at 6 *d.* according to our rule we will have

6 | 8) 2 *viz.* 8—6=2 at 8 *d.*
  | 4) 2 6—4=2 at 4 *d.*

Hence there is gained juſt as much by ſelling the lower priced ſimple at 6 *d.* as there is loſt in ſelling the other at 6 *d.*; for by ſelling at 6 *d.* what was valued at 4 *d.* there is juſt 2 *d.* gained, and by ſelling at the ſame price what was valued at 8 *d.* there is juſt 2 *d.* loſt. And what is true in this, will likewiſe be true in every caſe of this kind, whatever be the number of ſimples, and with however many others any one is linked: for as it is always a greater with a leſſer, there is a balance of gain and loſs upon the quantities taken from every linking of two ſimples, and therefore there muſt be a balance on the whole.

The quantities found by this caſe may be multiplied for greater quantities, or divided for leſſer, by the ſame number at pleaſure; and therefore, if the anſwer found is either leſs or more than ſuits the purpoſe, it may be increaſed or diminiſhed in proportion to the ſtock of the ingredients on hand for making the mixture.

Caſe 7. When the mean price, the particular prices of all the kinds to be mixed, and the quantity of one kind, are given to find the quantites of the other ingredients.

RULE.

Firſt, find what quantities would ſolve the queſtion, if no particular quantity had been given, by the laſt caſe; and ſince any other numbers in the ſame proportion will anſwer the queſtion, it will be, as the difference belonging to that price, whoſe quantity is given, is to the given quantity, ſo is each of the other differences to its reſpective quantity ſought.

Example. Suppoſe a grocer with 10 lb. of ſugar at 10 *d.* would mix with ſorts at 4 *d.* 5 *d.* and 8 *d. per* lb. and ſell the compoſition at 7 *d. per* lb. what quantity muſt he take of each ſort?

					d.	
7	10) - - 3	Then	as 3 : 10 :: 3 :	10	at 4=	40
	4) - - 3		as 3 : 10 :: 1 :	$3\frac{1}{3}$	at 5=	$66\frac{2}{3}$
	5) - - 1		as 3 : 10 :: 2 :	$6\frac{2}{3}$	at 8=	$53\frac{4}{3}$
	8) - - 2		as	10	at 10=	100
				30	at 7=	210 Pence.

Caſe

Caſe 8. When the mean price with the particular prices of each ſimple, and the quantity of the whole mixture, are given to find the particular quantity of each ſimple of the mixture.

RULE.

Firſt find what quantities would ſolve the queſtion, if the quantity of the whole mixture was not limited; then it will be, as the ſum of all the differences is to the whole quantity given, ſo is each particular difference to its particular quantity ſought.

Example. How many buſhels of rye at 3*s.* 6*d.* barley at 2*s.* 4*d.* wheat at 4*s.* 3*d.* and oats at 1*s.* 4*d. per* buſhel, muſt be taken to compound a mixture of 98 buſhels at 2*s.* 6*d. per* buſhel.

Becauſe $49 = \frac{1}{2}$

38	42	- - 14	as	1	:	2	::	14	: 28 rye.
	28	- - 21	as	1	:	2	::	21	: 42 barley.
	51	- - 2	as	1	:	2	::	2	: 4 wheat.
	16	- - 12	as	1	:	2	::	12	: 24 oats.
		49							

Each of the laſt ſeven caſes is illuſtrated with but one example, not only becauſe the operations are extremely eaſy, but likewiſe very ſeldom occur.

Variety IV. Warehouſe and Shop Computations of Loſs and Gain.

IN buying and ſelling, it is not only neceſſary for a merchant to be a perfect judge of the quality of goods, and to be well acquainted with the propereſt markets for making the beſt purchaſes and quickeſt ſales, but he muſt likewiſe be able, by comparing both together, on the different articles in which he deals, to make a true eſtimate of his trade, thereby to judge with certainty, in what articles he ought to launch out, and in what to retrench, as he finds them more or leſs to his account. To effectuate this, it was found neceſſary to have ſome common ſtandard, by which the gain or loſs made, or propoſed to be made upon any commodity, or article in trade, ſhould be tried and expreſſed; and this, by univerſal conſent, ſeems to have been fixed to the *centum* or hundred; ſo that when we ſay the gain is at 10 *per cent.* it is to be underſtood, that

that when 100 *l.* 100 guineas, 100 crowns, 100 ſhillings, *&c.* have been laid out in purchaſing goods, 110 *l.* 110 guineas, 110 crowns, 110 ſhillings, *&c.* have been recovered by the ſales; and, in the ſame manner, if 100 *l. &c.* were laid out on the purchaſe of goods, and but 90 *l.* received back, we would ſay that 10 *per cent.* was loſt by ſuch goods.

This variety will admit of four caſes.

Caſe. 1. When the buying and ſelling prices are known, and the rate *per cent.* gain or loſs required.

RULE.

As the buying price is to the difference betwixt the buying and the ſelling price, ſo is 100 to the gain or loſs *per cent.*

Exam. 1. Bought cloth at 15 *s.* 6 *d.* and ſold it again for 18 *s.* what did I gain *per cent.*?

6 *d.* 6 *d.* 6 *d.* 6 *d.* 6 *d.*

31 : 36—31=5 :: 100 : $16\frac{4}{31}$ *per cent.*

For 31) 500

$16\frac{4}{31}$ *Anſwer.*

Hence had 100 ſixpences been laid out on cloth at 15 *s.* 6 *d.* which was ſold again for 18 *s.* there would have been gained $16\frac{4}{31}$ ſixpences; if 100 ſhillings, the gain would have been $16\frac{4}{31}$ ſhillings; and if 100 pounds, the gain would have been $16\frac{4}{31}$ pounds, *&c.*; for the proportion would ſtill have been the ſame, as will be evident from the laſt example performed the common way.

15-6	2-6	*L.* 100		
12	12	240		
186 *d.*	30 *d.*	:: 24000		
		30		
		720000	12	
	186)	558	(3870	
		1620	20)32|2 6	
		1488	16-2-6$\frac{1}{4}$=$16\frac{4}{31}$	
		1320		
		1302		
		180		

2 *Exam.*

Exam. 2. Bought cloth for 10 *s.* and ſold it again for 9 *s.* what did I loſe *per cent.*?

10) 100

10 *per cent.*; for 10 : 1 :: 100 : 10

Exam. 3. Bought 5 puncheons of rum for 245 *l.* 19 *s.* 6 *d.* and ſold them immediately for 295 *l.* 19 *s.* 6 *d.* what did I gain *per cent.*?

First, 295.975 the ſelling price.
245.975 the buying price.

5) 245.975 : 50. :: 100

5) 49.195 10

9.839 - - - - -) 200.000 ($20\frac{3220}{9839}$ *per cent.*
196.78

3.220

The ſhillings and pence are reduced to decimals mentally, and therefore the operation left out.

Exam. 4. Bought a puncheon of rum for 66 *l.* 13 *s.* 4 *d.*; it runs 150 gallons, which I retailed at 12 *s.* 6 *d.* *per* gallon; whether did I gain or loſe, how much, and at what *per cent.*?

2) 150 gallons.

4) 75 0 at 10 *s.*
18 15 at 2 *s.* 6 *d.*

93 15 0 ſelling price.
66 13 4 buying price.

2 : 27 1 8 :: 3
3

2) 81 5 0

40 12 6 *per cent.*

Becauſe 66 *l.* 13 *s.* 4 *d.* is juſt $\frac{2}{3}$ of 100 *l.* 2 is made the firſt term; and becauſe $\frac{3}{3} = 100$ *l.* 3 is made the laſt term; ſo by the anſwer there is gained 27 *l.* 1 *s.* 8 *d.* which is $40\frac{4}{9}$ *per cent.*

Caſe 2. When the buying price, and the propoſed rate *per cent.* profit are given, to find the advanced price.

R U L E.

100 in this caſe will be the firſt term, the rate added to 100 the ſecond, and the buying price the third, the 4th proportional to which is the advanced price required.

Exam. 1. Bought cloth at 15 *s. per* yard, how may I charge it *per* yard, to gain 25 *per cent.*?

s.	*s.*		*s.*	*s. d.*
100	: 125	::	15	: 18-9.

For abridging the terms, 3

20) 375

18-9 *Anſwer.*

Exam. 2. Bought 400 ſpyndles of yarn for *L.* 41, carriage and other charges came to 17 *s.*; how may I retail it *per* ſpyndle, to clear 30 *per cent.*?

	L.	*s. d.*
400 : 13 ::	41.85	: 2-7$\frac{1}{2}$.

13

4) .54405

.13601 = 2 *s.* 8$\frac{1}{2}$ *d. per* ſpyndle.

When a cipher is cancelled in the product of 400×100 the firſt term, and one cancelled likewiſe in the 2d term 130 to balance it, the queſtion will be properly ſtated as above; and if from the product of the 2d and 3d terms, 5 places be conſidered as decimals, for the 2 in the 3d term, and the 3 ciphers in the diviſor, the product will be a fraction, and the diviſor 4.

Exam. 3. Bought 80 puncheons of rum, containing 7548 gallons, at 10 *s.* 6 *d. per* gallon, lighterage, porterage, and other charges came to *L.* 25, 7 *s.*; there was of leakage 25 gallons; how may I ſell the remainder *per* gallon, to clear 12$\frac{1}{2}$ *per cent.* upon the whole?

7548 gal.
25 leak.

7523 rem.
100 ×

752300 : 112.5 :: First, 7548

3774. at 10 *s.*
188.7 at 6 *d.*
25.35 of charge

3988.05 first cost : 11 *s.* 11 *d.*

For 3988.05
$112\frac{1}{2}$

446661.6
1994.05

7523) 448655.65 (.59636=11 *s.* $11\frac{1}{2}$ *d.*
37615

72505
67707

47986
45138

27485
22569

49160
45138

(4022)

Exam. 4. Bought 17 cwt. 3 qrs. of ſugar, at 60 *s.* and 14 cwt. 2 qrs. and 14 lb. at 70 *s.* which I mixed together, and propoſe to ſell at 30 *per cent.* advance; how may I value one cwt. of the mixture to effectuate my purpoſe?

L.

First, 17.75 ×3 = 53.25
14.625×3½ = 51.1875

Quantity 32.375 104.4375 prime coſt.
13

323.75) 1357.6875 (4.1936=L. 4, 3 s. 10½ d.
129500

6.687
32375

30.125
29 1375

117500
97125

203750

Caſe 3. If the rate proportional to another upon a new advanced price is required.

RULE.

The loweſt advanced price will be the firſt term, the rate added to 100 will be the 2d, the higheſt advanced price the 3d, and the 4th proportional will be the advanced price required, after 100 is deduced from it.

Exam. 1 Sold tobacco at 7 *d. per* lb. upon which I had 10 *per cent.* markets roſe to 8 *d.*; what did that advance bring *per cent.*?

7 *d.* : 110 :: 8 : 125$\frac{5}{7}$
110

7) 880

125$\frac{5}{7}$
100

25$\frac{5}{7}$ *per cent. Anſwer.*

Exam.

Exam. 2. Sold cloth at 18 *s.* upon which I had 15 *per cent.*; how much *per cent.* had my neighbour, who ſold his cloth of the ſame coſt, at 19*s.* 6*d*? *Anſwer*, 24$\frac{1}{2}$ *per cent.*

Caſe 4. If the prime coſt is required, 100 added to the rate *per cent.* will be the firſt term, 100 the ſecond, the advanced price the third, and the fourth proportional the prime coſt required.

Exam. 1. Sold a pipe of wine for *L.* 43, 15 *s.* by which I had 20 *per cent.* what was the prime coſt?

			L.	*L. s. d.*
120	: 100	::	43.75	: 36 9 2
Abridged 6	: 5	::	43.75	
			5	
			6) 218.75	
			36.4583 = *L.* 36 9 2	

Exam. 2. Sold 50 pieces Scotch lawns, 10 yards each, for 135 *l.* by which I had 15 *per cent.* what did it coſt me *per* yard?

115×500	: 100	::	135	: 4*s.* 8$\frac{1}{4}$ *d.*
Abridged 115	: 1	::	27	
			20	
			540	(4 8$\frac{1}{4}$ *s. d.*
			460	
			80	
			12	
			960	
			920	
			40	
			4	
			160	
			115	
			(45)	

OBSER.

OBSERVATION.

In ſelling on credit, merchants generally propoſe a certain profit, which they calculate upon the prime coſt of the goods, added to the real and imaginary charges.—The real charges on goods are freight, inſurance, lighterage, porterage, ware-room rent, *&c.* and the imaginary charges are riſk of bad debts, dilatory payments, ſhort inſurance, poſſible accidents in the carriage, riſk of having them long on hand, *&c.*; and where this calculation is made according to the profit they propoſe, the goods are marked on the cover with ſomething characteriſtical of the price, which is known only to thoſe concerned in the ſhop or ware-room. After all, merchants are frequently obliged to conform themſelves to the market, ſelling under the rate they propoſed, when there are few bidders, and as demands riſe, taking the beſt price they can get.

Variety V. COMPUTATIONS IN BARTER.

BArter is the commutation of one commodity for another, and teacheth ſo to proportion the quantities to be exchanged, according to the conditions of the barter, that neither party may ſuſtain loſs. Queſtions of this kind may be quickly reſolved by one ſingle operation, by the following

RULE.

Let the rate of the aſſigned quantity *per* yard, lb. cwt. *&c.* be put for the firſt term, the given or aſſigned quantity for the ſecond term, and the rate of the quantity required for the third term, in a reciprocal proportion, then will the fourth proportional be the anſwer.

Exam. 1. How many yards of ſhalloon may I have in barter for 80 yards of broad cloth, rating the broad cloth at 15*s.* 6*d.* and the ſhalloon at 2*s.*?

6*d.*	*yds.*	6*d.*	*yds.*
31	80	4	620
	31		

4) 2480

620 yds.

Or $\frac{80}{4}$=20×31=620 yards of ſhalloon as before.

Exam.

Exam. 2. How many yards of Iriſh linen at 2 *s.* 3 *d.* may I have in barter for 80 pieces holland of 20 yards each, at 3 *s.* 6 *d. per* yard?

threepences *threepen.*
114 : 80×20 :: 9 : $2488\frac{8}{9}$

For 80
20
1600
14
9) 22400
$2488\frac{8}{9}$

Exam. 3. How many pieces of Indian chints may I have in barter for 86 pieces of broad cloth, rating the former at *L.* 25, 10 *s.* and the latter at *L.* 15, 15 *s.*?

15 *s.* *pieces.* 15 *s.*
21 : 86 :: 34 : $53\frac{8}{17}$

For 86
21
172
34) 1806 (53
170
106
102
4
$34=\frac{8}{17}$

Exam. 4. How many lb. of almonds may I have in barter for 379 lb. of raiſins, reckoning the almonds at $7\frac{1}{2}$ *d.* and the raiſins at $3\frac{3}{4}$ *d.*?

$3\frac{3}{4}$ *d.* $3\frac{3}{4}$ *d.*
1 : 379 :: 2 : $189\frac{1}{2}$ *lb.* of almonds.

Exam.

Exam. 5. How many Bibles at 2 *s.* Salmon's gazetteers at 4 *s.* and ſpelling-books at 1 *s.* of each of an equal number, may I have in barter for 525 dictionaries at 6 *s.* each?

s. *books.*
6 : 525 :: 2+4+1=7 : 450

For 7) 525
75 $\frac{5}{7}$ to be deduced.

450 of each.

which amounts to the ſame as multiplying by 6, and dividing by 7.

There is a ſecond ſpecies of barter taken notice of by moſt authors, wherein it is thought neceſſary, when one of the parties makes a diſtinction betwixt a bartering and ready money price, to proportion the price of the other party's goods to the ſame advance with the former; but as this only multiplies figuring to no purpoſe, ſince the ſame anſwer can be found as above, it was judged proper to take no further notice of it here.

Variety VI. COMPUTATIONS in PARTNERSHIP.

WHen two or more merchants join together to carry on any branch of buſineſs, they are ſaid to be in partnerſhip or company; and if their ſtocks are all equal, the gain, loſs, or proceeds that each partner muſt ſuſtain, or draw from the concern, is found by dividing either by the number of partners; when their different ſhares of the capital have one common denominator, their reſpective ſhares of gain, loſs, or proceeds, are found by multiplying the gain, loſs, or proceeds by their reſpective numerators, and dividing the product by the common denominator. When each partner puts in a certain ſum, as beſt ſuits his inclination or abilities, his ſhare of gain, loſs, or proceeds muſt be proportioned to his ſtock. And, laſtly, when the partners not only put into the company-trade different ſtocks, but enter or withdraw theſe ſtocks at different periods, and perhaps both, each partner's ſhare of gain, loſs, or proceeds muſt be proportioned to his ſhare of the capital, and the time it was employed. Hence will ariſe four caſes.

Caſe 1. When the capital is divided into equal ſhares, each partner's dividend of the gain, loſs, or nett proceeds, is found, by dividing the whole gain, loſs, or nett proceeds by the number of partners.

Exam. A, B, and C had each in the common ſtock *L.* 500; when their books were balanced, they found there was of nett gain *L.* 550; how much muſt be carried to each partner's account in company?

3) 550

L. 183-6-8 *Anſwer.*

Caſe 2. When the different ſhares of the capital have one common denominator, divide the gain, loſs, or proceeds by that denominator, and multiply the quotient by their reſpective numerators.

Ex. A, B, C, and D, were concerned in a ſtore in Virginia, whereof A had $\frac{1}{2}$, and B, C, and D each $\frac{1}{6}$; when the ſtore was ſold off, and the debts collected, there was a clear capital of *L.* 5000; what is the dividend to each?

6) 5000

833	6	8 to B.
833	6	8 to C.
833	6	8 to D.
2500	0	0 to A.
5000	0	0 as given.

Caſe 3. When each partner ſtocks in a ſum at random, as ſuits his convenience or inclination; let the whole capital be the firſt term, the proceeds, gain, or loſs, the ſecond, and each partner's ſtock the third; then will the ſhare of gain, loſs, or proceeds, due to that partner whoſe ſhare of the capital was the third term, be the fourth proportional.

Ex. 1 A, B, and C freight a ſhip to Jamaica; A puts in goods to the value of 475 *l.* 10 *s.* B to the value of *L.* 675 : 3 : 4, and C to the value of *L* 834 : 6 : 8, including charges: they gained 547 *l.* 19 *s.* on the voyage: What is the dividend to each, in proportion to his ſhare of the capital?

	L.	s.	d.				
A=	475	10	0				
B=	675	3	4				
C=	834	6	8				
Capital	1985	0	0	: 547.95 gain.			
Abridged	397	0	0	: 109.59	:: $475\frac{5}{4}$	:	131.259=A
	397	0	0	: 109.59	:: $675\frac{5}{7}$	:	186.376=B.
	397	0	0	: 109.59	:: $834\frac{1}{3}$	:	230.315=C.
							547.95 Proof.

Sometimes the anſwer can be found more expeditiouſly, by finding the ſhare of gain, loſs, or proceeds, due to 100 *l.* and performing the reſt of the operation by practice, eſpecially where there are few fractions.

Ex. 2. A, B, and C freight a ſhip to Virginia, A contributed to the adventure 500 *l.* B 1200 *l.* and C 1300 *l.*; they had returns in tobacco, the nett proceeds whereof amounted to 3800 *l.*; what is the dividend to each?

First,	3000	:	3800	::	100		
Abridged	3	:	38	::	10		
			10				
			3) 380				
			126	13	4	*per cent.*	
					5		
500 =	633	6	8	A draws	633	6	8
500 =	633	6	8				
200 =	253	6	8	B draws	1520	0	0
1200 =	1520	0	0				
100 =	126	13	4	C draws	1646	13	4
				Proof	3800	0	0

It will have the ſame effect, and ſometimes the proceſs will be ſtill ſhorter, to find the proportional ſhare of gain, loſs, or proceeds, to 1 *l.* and do the reſt by practice.

Ex. 3. A B, and C fit out a ſhip for Martinico, for which they

they pay their 300 guineas each. A puts into the common ſtock, for the purchaſe of ready-money goods, 274 *l.* B 389 *l.* and C 437 *l.* Moreover, they buy upon their joint credit goods at twelve months, to the amount of 2750 *l.* : porterage, lighterage, packing, and ſhipping-charges, were paid out of the ready money.—A goes ſupercargo, and is allowed $2\frac{1}{2}$ *per cent.* proceeds for his trouble of management. Each partner's ſhare of nett proceeds for the ready money advanced was to be proportioned to his inputs, but for the goods on credit they ſhared equally.—A arrives with a bill of exchange for 1000 *l.* and ſugar, which, after all charges were deducted, they ſold for 4785 *l.* A's bill of charges and commiſſion came to 360 *l.*; how will the remainder be divided?

Advanced by A in caſh	*L.* 274	Returns in ſugar	*L.* 4785
Ditto by B, - -	389	In a bill of exchange	1000
Ditto by C, - -	437	Total returns -	5785
Total advances in money	1100	Deduct charges, *&c.*	360
Upon the common credit, - - - - - - - -	2750	Nett proceeds, *L.*	5425
Total of the capital, -	3850		

To find the dividend upon 1 *l.* it will be

cap.	*proceeds.*	*cap.*
3850 :	5425 ::	1
Abridged 154 :	217 ::	1 *L.* 1-8-2 $\frac{2}{11}$

Since A put in - - *L.* 274

For 1 *l.* he draws	274		
For 6 *s.* $8\frac{1}{3}$ *d.* - -	91	6	8
For 1 *s.* $4\frac{1}{3}$ *d.* - -	18	5	4
For $2\frac{1}{3}$ *d.* - - -	2	5	8
For $\frac{2}{11}$ $\frac{1}{11}$ - - -	0	4	$1\frac{1}{4}$

Note, Theſe methods prove each other alternately.

Note, The ſhip makes no alteration, unleſs it had been ſold at loſs or profit

For 154 : 217 :: 274 : *A*'s ſhare, *L.* 386 1 $9\frac{1}{4}$.

A's ſhare brought forward, L. 386 1 9

Since B put in - - L. 389 0 0

$\frac{1}{3}$ = 129 13 4
$\frac{1}{7}$ = 25 18 8
$\frac{1}{8}$ = 3 4 10
$\frac{1}{11}$ = 0 5 10$\frac{1}{2}$

For 154 : 217 :: 389 : B's ſhare, L. 548 2 8$\frac{1}{2}$

And ſince C put in L. 437 0 0

$\frac{1}{3}$ = 145 13 4
$\frac{1}{7}$ = 29 2 8
$\frac{1}{8}$ = 3 12 10
$\frac{1}{11}$ = 0 6 7$\frac{3}{4}$

For 154 : 217 :: 437 : C's ſhare, L 615 15 5$\frac{1}{4}$

Laſtly, 154 : 217 :: 1100 : L. 1550 0 0 ready-money proceeds.

From the total proceeds 5425
Deduct - - - 1550

Remains - - - 3875
Deduct goods on credit, 2750

1125

To be divided equally $\frac{1}{3}$ to each, - L. 375, which being added to their ready money ſhares reſpectively, gives the particular ſum which each partner draws out of the concern.

Queſt. 4. A, B, and C buy a ſhip for 1200 *l.* whereof A had $\frac{1}{3}$, B $\frac{1}{3}$, and C $\frac{1}{4}$, how much money paid each?

First,

$\frac{1200}{3}$ = 600
$\frac{1200}{3}$ = 400
$\frac{1200}{4}$ = 300

1300

Then 1300 : 1200 :: 100
Abridged 13 : 12 :: 100 : 92-6-1$\frac{11}{13}$.

But

But *L.* 92 6 $1\frac{1}{11}\times6$=553 16 $11\frac{1}{11}$
92 6 $1\frac{1}{11}\times4$=369 4 $7\frac{3}{11}$
92 6 $1\frac{1}{11}\times3$=276 18 $5\frac{7}{11}$

13=1200 0 0 Proof.

Exam. 5. A, B, C, and D purchaſe a ſhip, whereof A had $\frac{1}{3}$, B $\frac{1}{4}$, C $\frac{1}{5}$, and D paid 500 *l.*; what was D's ſhare of the ſhip, how much money paid each of the reſt, and what coſt the ſhip all together?

Then 13 : 500 :: 20
20

3×4×5=60 denominator.

1×4×5=20 A's numerator.
1×3×5=15 B's numerator.
1×3×4=12 C's numerator.
Complem. 13 D's numerator.

60

13) 5000

4) 769 4 $7\frac{3}{4}$ A paid.
192 6 $1\frac{3}{4}$ Deduct $\frac{1}{4}$.

5) 576 18 $5\frac{1}{5}$ B paid.
115 7 $8\frac{3}{10}$ Deduct $\frac{1}{5}$.

12) 461 10 $9\frac{1}{2}$ C paid.
38 9 $2\frac{4}{5}$ Add $\frac{1}{12}$.

Proof 500 0 0 D paid.

Then A+B+C+D=2307 13 $10\frac{1}{4}$.
the price of the ſhip.

In real partnerſhip there are few inſtances where the ſhares of the company's capital are ſo undetermined as in ſome of the laſt examples; if they are not determined by one common denominator, they are generally even hundreds; or if one advance more than another, the difference is made up by an intereſt-account, at balancing the books. But this caſe is of ſingular uſe in ſettling compoſitions in bankruptcy, and average-loſſes in inſurance, to which we refer.

Caſe 4. When the partners give in or withdraw their ſtocks at different periods, multiply each partner's ſtock into the time it was employed, and the ſum of the products will be the firſt term; the gain, loſs, or proceeds the ſecond; and each particular product the third; then will the fourth proportional be the ſhare of gain, loſs, or proceeds due to that partner, the product of whoſe money and time was the third term.

term. Or the proportional ſhare of gain may be found to 1*l.* as above, and the reſt performed by practice or multiplication, as ſeems moſt convenient for diſpatch.

Queſt. 1. Four merchants, A, B, C, and D enter into partnerſhip thus:

A put in *L.* 64 10 0 for $4\frac{1}{2}$ months,
B - - 78 15 0 for 6 months,
C - - 112 14 0 for $8\frac{1}{4}$ months,
D - - 125 5 0 for $5\frac{1}{2}$ months,

They gain 108 *l.* 18 *s.* $4\frac{1}{2}$ *d.*: what is due to each in proportion to their ſtocks, and time they were reſpectively employed?

		L.	*mon.*	
First,	A's ſtock	64.5	×4.5	=290.25
	B's ſtock	78.75	×6	=472.5
	C's ſtock	112.7	×8.75	=986.125
	D's ſtock	125.25	×5.25	=657.5625

The ſum of the products 2406.4375

Then 2406.4375 :	108.91865 :	*A.*	*L.*	
Abridged 19.2515 :	.8719 : :	290.25	: 13.137	A's gain.
19.2515 :	.8719 : :	472.5	: 21.3859	B's do.
19.2515 :	.8719 : :	986.125	: 44.633	C's do.
19.2515 :	.8719 : :	657.5625	: 29.762	D's do.
			108.9179	Proof.

Or thus,

19.2515 : .8719 : : 1 : .045261 gain due to 1 *l.*

Then	290.250	472.500
Multipler inverted	162540.0	162540.0
	11.6100	18.9
	1.4513	2.3625
	.580	945
	.174	284
	 3	5

A's gain = 13.1370 B's gain = 21.3859

986.125	657.5625
162.540.0	162.540.0
39.445	26.3025
4.9306	3.2878
.2272	.1315
..592	365
...10	7

C's gain = 44.633 D's gain = 29.762
The several shares as before.

Questions of this kind seldom or never occur in business; all differences in point of time are in company-affairs settled by an interest account, and therefore to multiply examples on the head would be entirely useless.

Variety VII. Bankruptcy and Computations relating to Compositions.

Bankruptcy is the failure, absconding, and relinquishment of traffic in a merchant, banker, or any other trader.—In the first ages of banking, the dealers in exchange had benches erected in the public places, upon which they told their money, and wrote their bills, *&c.* as the itinerant merchants, or chapmen have at this day.—When a banker failed in his circumstances, his bench was broke, either to denote a fraud, or advertise the public, that the person to whom the bench belonged was no longer to be trusted; hence the term *bankruptcy* is of Italian extraction, from two words signifying a *broken bench.*

The French distinguish betwixt a bankruptcy and a failure by stamping the idea of a designed fraud on the first, whilst the latter is construed as occasioned by misfortunes and necessity.

In *stat.* 1. *Ja.* I. *c.* 15. we have this description of a bankrupt, *viz.* All and every person who shall use the trade of merchandise, by way of bargaining, exchange, bartering, or otherwise, in gross, or by seeking his or her living by buying and selling, who shall depart his house, or absent himself, or suffer himself to be arrested for any debt, either for money delivered, wares sold, or other good consideration;

or

or ſhall ſuffer himſelf to be outlawed, or go to priſon, or fraudulently procure himſelf to be arreſted, or his money or goods attached, or make any fraudulent conveyance of his lands, goods, or chattels, whereby his creditors may be defeated in the recovery of their juſt debts; or, being arreſted for debt, ſhall lie in priſon ſix months, or more, upon ſuch arreſt, or detention, ſhall be adjudged a bankrupt.

When it is judged that a merchant hath become a bankrupt, not out of neceſſity, but with a view to defraud his creditors, and ſave a capital at their expenſe; a commiſſion of bankruptcy may be taken out againſt him under the great ſeal, directed to five or more commiſſioners, to enquire into the particulars of the failant's circumſtances, and to act conformably to certain ſtatutes made in that behalf.

Subſtance of the laws relating to bankruptcy in England.

13. *Eliſ. c.* 7. Thoſe who depart the realm, conceal themſelves, or permit themſelves to be falſely arreſted, to defraud creditors, if they were in trade, are deemed bankrupts.—The Lord Chancellor, upon a complaint in writing againſt a bankrupt, appoints commiſſioners to ſell the bankrupt's lands, as well copy as free, annuities, goods, chattels, debts, *&c.* Theſe commiſſioners have power to convene perſons ſuſpected to have any of the bankrupt's effects.—Perſons refuſing to diſcloſe, or detaining lands, *&c.* to forfeit double the value.—If the perſon indebted abſent himſelf, after five proclamations by commiſſioners, to be out of the King's protection, and perſons concealing him to be impriſoned and fined.—The creditor, not ſatisfied, may afterwards take his courſe at law.

Stat. 1. *Ja. c.* 15. A creditor ſhall be received if he come in, in four months.—Grants of land, *&c.* of a bankrupt in other mens names, except to children upon marriage, or for a valuable conſideration,—void.—If, upon warning left at the uſual place of reſidence three times, the bankrupt does not appear, five proclamations to be made, *&c.* Refuſing to be examined, ſhall be committed.—Committing perjury, to 10*l.* prejudice of creditors, to ſtand on the pillory.—Perſons ſuſpected to detain any of the eſtate not appearing, to be arreſted; and ſtill refuſing, to be committed.—Commiſſioners may aſſign debts, *&c.* to the creditors, and proceed to execution though the bankrupt dies.—Commiſſioners to render the bankrupt an account, and pay overplus.

Stat. 21. *Ja. c.* 19. Perſons endeavouring to compel creditors to take leſs than their due, or to gain time beyond ſix months, and eſcaping, *&c.* adjudged bankrupts.—Bankrupt's wife may be examined on oath.—Bankrupt fraudulently concealing to ſtand on the pillory.—Commiſſioners may break open a bankrupt's houſe, cheſts, *&c.* Another man's goods in the bankrupt's houſe to be diſtributed.—No reſpect to be had to debts upon judgement, recogniſances, or ſpecialties, beyond other debts. *St.* 12. and 14 *Car.* II. *c.* 14. 9. *&c.*—10. *W.* III. *c.* 44. Adventurers in the Eaſt-India company, Guinea company, *&c.* and no member of any ſociety or company, to be adjudged a bankrupt in reſpect of his ſtock; and the ſtock not liable to foreign attachment.

Stat. 5. *G.* II. *c.* 30. Bankrupts not ſubmitting to be examined thirty days after notice, and not diſcovering how they have diſpoſed of their goods, and all books, papers, *&c.* and delivering up all to the commiſſioners, all ſuch eſtate, *&c* except their wives and childrens neceſſary wearing apparel, to ſuffer as felons.—No advantage to bankrupts giving above 100*l.* in marriage with children, unleſs at the time they could ſatisfy their debts.—Bankrupts removing, concealing, or embezzling, to the value of 20*l.* guilty of felony.—No commiſſion of bankruptcy to be iſſued out, unleſs, the debt of one creditor petitioning amount to 150*l.* or of three to 200*l.*—and bond to be given in 200*l.* penalty, to prove the party a bankrupt.

Stat. 6. *G.* I. *c.* 21. and 7. *G.* I. *c.* 31. A bankrupt in priſon, on execution for debt, to be diſcharged, producing his certificate.—And perſons having bills or notes on bankrupts, at a day to come, entitled to dividend, allowing diſcount at 5 *per cent.*

Stat. 5. *G.* II. *c.* 30. Bankrupts not ſurrendering in forty-two days, and not diſcovering eſtates, adjudged guilty of felony; but the Lord Chancellor may give ſeventeen days further reſpite.

They are to deliver all books of accounts, writings, *&c.* to aſſignees on oath, and be allowed 5 *per cent.* not above 200*l.* on paying 10*s.* in the pound, and 7½ *per cent.* not exceeding 250*l.* on paying 12*s.* 6*d.* *per* pound; and the body, not the eſtate, of the bankrupt to be diſcharged, unleſs he pays 15*s.* in the pound.

Four parts in five in number and value of creditors are to

ſign certificates, *&c.* Bonds or notes given to conſent to any certificates, to be void; and if any creditor ſuing out any commiſſion, has privately more than others, the commiſſion ſhall be ſuperſeded.——Bankrupts to be apprehended upon a commiſſion iſſued.——Perſons who diſcover their eſtates to be allowed 5 *per cent.* and concealing truſts to forfeit *L.* 100 and double value.——Notice muſt be given to creditors to meet and chuſe aſſignees, prove debts, *&c.*; but none to vote where a debt is under *L.* 10.——New aſſignees may be choſen by the creditors, and aſſignees at the end of four months, and within twelve, to account, and dividend to be made; and there may be a ſecond final dividend in eigteen months, *&c.*—— Commiſſioners to take an oath,—allowed 20*s.* a day, but nothing for expenſes, and attorney's bill to be adjuſted by a maſter in chancery.

Bankers, brokers, or factors, are ſubject to ſtatutes of bankruptcy; but farmers, graſiers, or receivers of taxes ſhall not be deemed bankrupts. *Stat.* 5. *and* 16. *Geo.* II.

Subſtance of the laws relating to bankruptcies in Scotland.

Will. & Mary, parl. 1. *ſeſſ.* 2. *c.* 20. The Lords ſhall adjudge the lands, *&c.* belonging to bankrupts, in favour of the buyer, by the decreet of ſale; and the buyer ſhall thereon be infeft, ſo ſoon as it ſhall be found that the debtor is utterly inſolvent, whether the legal be expired or not Moreover, if no purchaſer is found, a dividend may be made of the lands and eſtates among the creditors; as alſo the Lords may determine the value of liferent eſcheats, and the lands or price to be divided among the creditors, conform to their ſeveral rights and diligences.

Will. & Mary, parl. 1. *ſeſſ.* 6. *c.* 5. He is declared to be bankrupt, who, being under horning and caption, and found by decree of the Lords to be inſolvent, is either impriſoned or retired to the abbey, or other privileged place, or fled or abſconded, or who defends his perſon by force; which being found by a declaration of the Lords, all voluntary deeds made by the bankrupt, at or after, or in the ſpace of ſixty days before his becoming ſo, in favour of any of his creditors, either in ſatisfaction, or for ſecurity, ſhall be null and void; and heritable rights, whereupon infeftment may follow, granted by the ſaid bankrupts, are only reckoned, as to this caſe, to be of the date of the ſeiſin, but prejudice of their validity as to

other

other effects.—A fraudulent bankrupt is not only infamous *infamia juris*, but may be farther punished by the Lords of Session, death excepted, and no dispensing with the habit allowed in cession, unless the bankrupt failing through misfortune be libelled and proved.

Ja. VI. *parl.* 23. *c.*18. All alienations, dispositions, and assignations made by debtors of their lands, tiends, reversions and goods whatever, to any conjunct or confident person, without a true and just cause, after the contracting of their debts, may be declared null at the instance of just creditors. And if any third party purchase lawfully the said lands or goods from the said conjuncts or confidents, his rights shall stand, but the receiver of the price shall be liable to make the same forthcoming to the said creditors.—The fraud may be proved by writ or oath of the party receiver of the said security, that it was without any true or just cause; or that the lands and goods being again sold, the price, or most part thereof, is, or was to be converted to the bankrupt's behoof, *&c.*

The computations relating to this variety, when there are few creditors, may be made as in case 3. of the last variety.

Exam 1. Suppose a bankrupt's effects should amount to 1739*l.* 13*s.* 8½*d.* what dividend thereof will fall to each of the following creditors in proportion to their respective sums?

He owes to A,	*L.* 313	7	3	= 313.3625
to B,	290	4	6	= 290.225
to C,	700	0	0	= 700.
to D,	486	13	8	= 486.68333
to E,	600	0	0	= 600.
to F,	500	0	0	= 500.
to G,	381	10	0	= 381.5
to H,	418	0	0	= 418.
Total debt,	*L.* 3689	15	5	= 3689.77083

Debt. *Subject.*

3689.77083 : 1739.685416 ::

	L.	s.	d.	
313.3625	: 147	14	11¼	A
290.225	: 136	16	9¾	B
700.	: 330	0	10	C
486.683	: 229	9	3¾	D
600.	: 282	17	10½	E
500.	: 235	14	10½	F
381.5	: 179	17	5½	G
418.	: 197	1	8	H

drawn

L. 1739 13 8½ Proof.

By the above method it is plain, there must be an heavy multiplication and division for every creditor, which, when the creditors are numerous, would render the calculation intolerably tedious and troublesome, in which case, find the dividend for 1 *l.* and do the rest by practice; or, which will be much shorter, multiply the dividend for 1 *l.* into all the nine digits severally, and then into 10; multiply this last product into all the nine digits, and lastly into 10, so shall there be a table constructed, from which the several dividends, were the creditors ever so numerous, can easily be effected.

Let the last example be resumed.

3689.77083 : 1739.685416 :: 1

3689.77083) 1739.685416 (.4714875

4714875×	1 = .4714875	4.714875×	1 = 4.714875
	2 = .9429750		2 = 9.42975
	3 = 1.4144625		3 = 14.144625
	4 = 1.8859500		4 = 18.8595
	5 = 2.3574375		5 = 23 .74375
	6 = 2.8289250		6 = 28.28925
	7 = 3.3004125		7 = 33.004125
	8 = 3.7719000		8 = 37.719
	9 = 4.2433875		9 = 42.433875
	10 = 4.7148750		10 = 47.14875

Having thus tabulated the dividend to 1 *l.* the use of the table will be discovered from the following instances.

There was due to A 313 *l.* 7 *s.* 3 *d.*

By

By the table the dividend to 100=47.14875
For 300 multiply by 3

141.44625
L. 10= 4.714875
3= 1.4144625
6 s. 8 d.=⅓ of 1 l. .1571625
6 d.=1/120 of 1 l. .01178718
1 d.=⅛ of 1/120 .00183119

L. s. d.
147.74636837 =147 14 11¾
as before.

There was due to C 700
L. 100 in the table= 47.14875
For 700 multiply by 7

330.04125=L. 330 0 10 as before.
And ſo of any other.

When the compoſition is agreed on, or fixed betwixt the failant and his creditors, the dividend may be at once calculated for any ſum practically without a table, eſpecially if the parts can be eaſily taken.

Exam. 2. A B breaks, and offers his creditors 15 *s.* a-pound, which they agreed to accept of; what will C receive, whoſe debt amounts to 515 *l.* 7 *s.* 6 *d.*?

2) 515 7 6

2) 257 13 9 for 10 *s.*
128 16 10½ for 5 *s.*

386 10 7½ for 15 *s.* a-pound × 386 10 7½

Exam. 3. A B breaks, and offers his creditors 12 *s.* 6 *d.* a-pound, which they agree to receive; what is C's debt worth, amounting to 756 *l.* 19 *s.* 6 *d.*?

2) 756 19 6

378 9 9 for 10 *s.*
94 12 5½ for 2 *s.* 6 *d.*

473 2 2½ for 12 *s.* 6 *d.* *Anſwer.*

Exam.

Exam. 4. A B compounds his debt with his creditors at 5 *s.* 5 *d. per* pound Sterling; what will C receive, to whom he was due 500 *l.*?

4) 500

12) 125 at 5 *s.*
10 8 4 at 5 *d.*

135 8 4 at 5 *s.* 5 *d.* *Anſwer.*

Var. VIII. STOCK JOBBING.

TO render this ſubject more intelligible, it hath been thought proper to divide it into particular ſections.

SECT. I. *Of ſtocks, or transferrable funds.*

BY the word *ſtock*, was originally meant, a particular ſum of money contributed to the eſtabliſhing a fund, to enable a company to carry on a certain trade, by means of which the perſon became a partner in that trade, and received a ſhare of the profit made thereby in proportion to the money employed. But this term hath been extended further, though improperly, to ſignify any ſum of money which hath been lent to the government, on condition of receiving a certain intereſt, till the money is repaid, and which makes a part of the national debt. As the ſecurity, both of the government and of the public companies, is reckoned preferable to that of any private perſon, as the ſtock is negotiable, and may be ſold at any time, and as the intereſt is always punctually paid when it falls due; ſo they are thereby enabled to borrow money on a lower intereſt than what might be obtained from lending it to private perſons, where there muſt be always ſome danger of loſing both principal and intereſt.——But as every capital ſtock, or fund of a company, is raiſed for a particular purpoſe, and limited by parliament to a certain ſum, it neceſſarily follows, that when that fund is completed, no ſtock can be bought of the company; though ſhares already purchaſed may be transferred from one perſon to another. This being the caſe, there is frequently a great diſproportion between the original value of the ſhares and what is given for them when transferred: for if there are more buyers than ſellers, a perſon who is indifferent about ſelling, will not part with his

his ſhare without a conſiderable profit to himſelf; and, on the contrary, if many are diſpoſed to ſell, and few purchaſers appear, the value of ſtocks will naturally fall, in proportion to the impatience of thoſe who want to turn their ſtock into ſpecie.

The preſent government funds are,

1. Three *per cent.* reduced bank-annuities.
2. Three *per cent.* conſolidated ditto.
3. Three *per cent.* ditto, 1726
4. ditto, 1751
5. Three and a half *per cent.* ditto, 1756
6. Ditto, ditto, 1758
7. Four *per cent.* ditto, 1760
8. Long annuities, 1761
9. Four *per cent.* ſubſcription, 1762
10. Long annuities, 1762

Stocks of companies are,

1. Bank ſtock.
2. South-ſea ſtock.
3. India ſtock.
4. South-ſea annuities.
5. India annuities.
6. India bonds.

The funding ſcheme was introduced ſoon after the revolution, and hath hitherto anſwered the purpoſe for which it was calculated, *viz.* the providing for the exigencies of the ſtate in time of war, without the leaſt impeachment or diminution of its credit: whether this will always be the caſe, is a queſtion which futurity alone can decide. In our ſtatutes ſince the revolution various funds are ſpecified, ſuch as the Eaſt India, South-ſea, aggregate or general fund, and the ſinking fund.——Whenever the word *fund* is applied to the South-ſea or Eaſt India company, it means their ſtock or capital, or ſuch duties and articles of the public revenue as are appropriated to pay the intereſt due on ſuch ſtocks till redeemed by parliament. The aggregate fund is ſo called from its being a collection of many things incorporated together, comprehending not only the ſeveral rates and duties reſerved to pay and ſatisfy the intereſt due on the funds at the bank, India, and South-ſea houſe, but all the articles of the public revenue in general, excepting thoſe that compoſe the King's civil liſt, which likewiſe, by an act of the firſt year of our preſent Sovereign, make a part of the aggregate fund for *L.* 800,000, to be paid quarterly out of the ſaid aggregate fund.

SECT.

SECT. II. *The method of raiſing the annual ſupplies granted by parliament, for defraying the public expenſes of the ſtate, and the manner of ſubſcribing and negotiating ſubſcription, receipts,* &c.

THE ſupplies granted by parliament have been raiſed for ſome years paſt by annuities tranſferrable at the bank of England, ſometimes with, and ſometimes without a lottery. After the parliament have voted theſe ſupplies, if the ſubſcriptions have not been already ſecured by a few perſons of fortune, which is ſometimes the caſe, a public ſubſcription is ſet on foot; in which caſe, every reſponſible perſon is at liberty to apply, by a proper letter, to the firſt commiſſioner of the treaſury, for leave to be a contributor, ſpecifying in the letter the ſum which he would incline to contribute. But when the required ſum hath been previouſly ſecured by a private ſubſcription, the application muſt be directed to ſome of the monopoliſts. Sometimes indeed the ſubſcription lies open to the public at the bank, or at the exchequer, and in that caſe every perſon is allowed to ſubſcribe what he thinks proper; and ſhould there be a ſurplus, a proportional reduction is made upon each ſubſcription, that the whole may exactly correſpond with the ſum granted by parliament.

After the ſubſcription is cloſed, receipts are made out, and delivered to the ſubſcribers; and, for the conveniency of ſale, a ſubſcriber for a large ſum may have ſundry partial receipts for different proportions of his property; and a form of aſſignment is drawn upon the back of the receipt, which being ſigned and witneſſed, tranſfers the property to a purchaſer. The firſt depoſit is generally of 15 *per cent.* and is commonly made at the time of ſubſcribing, and every month thereafter a depoſit is made of 10 or 15 *per cent.* till the whole is paid up. Thoſe who chuſe to pay in the whole ſum before the appointed days, are allowed 3 *per cent.* from the date of ſuch payment till October; and the receipts for ſuch payments in full, in the language of the alley, are called *heavy horſe*, but the receipts for partial payments *light horſe*; becauſe the latter is much eaſier purchaſed than the former, and therefore more convenient for jobbing. An inſtance will be the beſt illuſtration. Suppoſe, in the month of March, juſt after the ſecond payment, one buys a receipt for 500 *l. ſcript.* or light horſe, for 25 *l.* the method of reckoning would be thus: Suppoſe the current price is 75 *per cent.* which is 25 *per cent.* below par; and as the purchaſer buys the ſcript. by itſelf, without the doceurs that accompanied it, he muſt be allowed the

diſcount, *viz.* 25 *per cent.* out of the payments already made, becauſe he is to continue paying in at par, in the ſame manner as if he had received the doceurs. The method of making out a bill for 500 *l.* ſcript. with two payments made upon it, is as follows:

	L.	
A ſells to B 500 ſcript. at 75 *per cent.* on which he hath made two payments, at 15 *per cent.* each,	150	0 0
B, not having the lottery-tickets, nor the long annuities, which are the douceurs, muſt be allowed 25 *per cent.* the difference betwixt the current price of 3 *per cent.* and par.	125	0 0
Balance to be paid to A for the receipt,	25	0 0

Hence it appears, that B becomes poſſeſſed of 500 *l.* ſcript. for 25 *l.* which he calls *light horſe*; and the advantage of ſcript. bought on theſe eaſy terms, is, that if a little riſe happens, the ſame profit of 1, 2, or 3 *per cent.* will preſent to the holder on this nominal ſum, as if the whole had been actually cleared off; and for this reaſon likewiſe, there is always a more ready market for light-horſe receipts than for heavy horſe, becauſe a purchaſer may have 25 *l.* who hath not 375 *l.*

SECT. III. *The method of buying into, and ſelling out of the public funds.*

THE buſineſs of ſtockjobbing is generally carried on by brokers, who, themſelves having ſeldom or never any property in the funds, make their fortunes by bubbling their clients, and have entered into a kind of conſpiracy to keep the method of trading in the ſtocks a myſtery to every one but themſelves.

Any perſon who wants to ſell or buy ſtocks, will eaſily diſcover his merchant amidſt the cries that reſound from all quarters:—If one means to be a purchaſer, he may, without the aſſiſtance of a broker, aſk another whom he hath diſcovered to be a ſeller concerning the price: who, if he is a common ſeller, will name the whole price, as 74½, 75¼, or what elſe it happens to be; but, if he is a doctor, or maſter of arts in the alley, he will only name you the fractional part of the price, to diſcover if you are a broker, eſpecially if he finds it to his account to deal with ſuch; he will go

about in ſearch of his merchant, as you muſt do in ſearch of yours. When your merchant appears, you then fix the price and the quantity, and give him your name, deſignation, and place of abode, that he, as the ſeller, may take care of the transfer, and prepare the receipt. In the mean time, it is your buſineſs to have the ſum ready in bank-notes, becauſe the hurry in negotiations of this kind is ſo great, that, in counting money, one is very liable to miſtakes; for which reaſon, thoſe who deal much in ſtocks, and are well known, make all payments by a draught on a banker, whom they have engaged, for a trifle of commiſſion, to clear all draughts of this kind. The transfer being prepared, and your name called, you then go to the clerk, who hath the transfer-book, to ſee the form in which the ſeller hath transferred the ſum agreed for, which ought to be to you, your heirs, aſſignees, *&c.* You will then be directed to ſubſcribe a form of acceptance of the ſtock transferred, the ſeller having firſt ſet his name to the transfer. This done, the clerk witneſſeth the printed receipt, which the ſeller gives you ſigned by him, which you muſt keep as a voucher of the transfer; then having paid the ſum, and taken the receipt, the whole buſineſs is tranſacted with reſpect to you as a buyer.

If you intend to ſell ſtock, get a quarter of a ſheet of paper, and write on it your name, deſignation, and place of abode, the ſum to be transferred, the fund whence it is to be transferred, and the perſon's name and deſcription to whom you have agreed to transfer it, as in the form below.

James Dinwiddy, *Eſq*; *of* Southampton-ſtreet,
in the pariſh of St Paul, Covent-garden,
500 *l.* 3 *per cent. conſolidated bank annuities*,

TO

Mr. James Simple *watch-maker on* Snow-hill,
in the pariſh of St. Sepulchre.

This paper muſt be delivered to the clerk neareſt to, or under the letter with which your name begins, who will examine your account, and prepare the transfer. In the mean time, it is your buſineſs to be making out the purchaſer's bill, which you are to do on a printed receipt, which you will be helped to, in the office, a copy whereof is hereto ſubjoined.

Conſolidated

Conſolidated 3*l. per cent. annuities, at* 74$\frac{5}{8}$.

Received the *day of* May 1762, *of Mr.* James Simple, *watchmaker on* Snow-hill, *the ſum of ſeventy four pounds, twelve ſhillings, and ſixpence, being the conſideration for one hundred pounds, intereſt, or ſhare, in the joint ſtock of three* per cent.*-annnities, erected by an act of parliament of the twenty-fifth year of the reign of King* George II. *entitled,* An act for converting the ſeveral annuities therein mentioned, into ſeveral joint ſtocks of annuities, transferrable at the bank of England, to be charged on the ſinking fund, *together with the proportional annuity at* 3*l.* per cent, per annum, *attending the ſame, by me, this day, transferred to the ſaid* James Simple.

Witneſs my hand,

Witneſs, James Dinwiddy.

John Gray, *Clerk.*

The receipt being thus made out, and the transfer ready, you ſign it in the book, and then deliver your receipt to the clerks, who ſign as witneſſes; after which deliver the receipt, and receive the money, and the whole affair is tranſacted.

Table, ſhewing the amount of the ſeveral ſtocks, the days and hours for transferring ſtocks and annuities, and the time of paying the dividends.

Amount of each capital.				Transfer-days.
Bank ſtock,	*L.* 10.780.000			
An. 3 *per cent.* red.	17.701.523	16	4	Tueſ. Wed. Thu. Fri.
Ditto conſolidated	21.627.821	5	1$\frac{1}{2}$	
Ditto 1729,	1.000.000			
Ditto, 3$\frac{1}{2}$, 1756,	1.500.000	-	-	Tueſ. and Thurſ.
Ditto 1758,	4.500.000	-	-	Mond. Wed. Frid.
4 *per cent.* do. 1760,	8.240.000	-	-	Tueſ. Wed. Thu. Fri.

Dividends due on bank-ſtock, and 3 per cent. *reduced, on the* 5*th April and* 10*th October, on the reſt the* 5*th of January and* 5*th of July.*

South ſea-ſtock,	*L.* 3.662.784	8	6	Mon. Wed. Frid.
Old annuities, -	12.404.270			
New annuities, -	8.958.255	2	10	Tueſ. Thurſ. Sat.
3 *per cent.* 1751, -	2.100.000			

South ſea ſtock new annuities, and 3 per cent. *dividends due on the 5th January and 5th July; old annuities, the 5th of April and 10th of October.*

India ſtock, - -	3.000.000 -	Tueſ. Thurſ. Satur.
Annuities, - -	3.000.000 - -	Mond. Wed. Frid.

Dividends due on bank ſtock, 5th of January and 5th of July.
ditto on annuities, 5th of April and 10th of October.

Hours of transferring.	Of paying dividends.
Bank-ſtock, from 9 to 12 - -	9 to 12, and 1 to 3.
South-ſea houſe, from 9 to 1. -	9 to 12.
India-houſe, ditto.	9 to 12, and 3 to 5.

The transfer-books are generally ſhut for a month before the time of paying dividends.

SECT. IV. *Computations in ſtockjobbing.*

Caſe 1. When the ſtock is any number of even hundreds, multiply the rate *per cent.* by the number of hundreds, and the product gives the price.

EXAMPLES.

1. Sold 500 three *per cent.* conſolidated annuities, at 75¼; what does it amount to?

75 12 6
5

£. 378 2 6 Anſwer.

2. Bought 700 India ſtock, at 135¾ *per cent.*; how much money muſt I pay?

135 15
7

950 5 Anſwer.

3. Sold

3. Sold 400 ſcript. at 92½, what ought I to receive?

92 10
4

370 0 Anſwer.

Caſe 2. When the quantity of ſtock, bought or ſold, is no even number of hundreds, multiply the quantity by the rate *per cent.* and divide the product by 100, the quotient gives the anſwer.

EXAMPLES.

1. What muſt I pay for 135 annuities 3½, at 87½ *per cent.*?

87.5
135

4375
11375

118.125=*L.* 118 2 6 Anſwer.

Or by practice, thus:

87 10 0 for *L.* 100 ann.
21 17 6 for 25
8 15 0 for 10

L. 118 2 6 as before

2. What muſt I receive for 29 *l.* 3 *per cent.* annuities, when the price is 74 *per cent.*?

74
29

666
148

21.46=*L.* 21 9 2½

Or

Or, by practice, thus:

74

14 16 0 for 20
2 19 $2\frac{2}{7}$ for 4
3 14 0

21 9 $2\frac{2}{7}$ as before.

3. What is the value of 97 *l.* 16 *s.* bank ſtock, at 120 *per cent.*?

97.5
120

117.000 Anſwer.

In this way are all computations in the ſtocks, and ſingle blanks and prizes, made; which is ſo eaſy and expeditious, that more examples would be quite unneceſſary.

SECT. V. *The cauſes of the riſe and fall of ſtocks.*

THOSE who are concerned in the practice of ſtockjobbing, frequently make contracts to buy or ſell, at a certain diſtant period, a certain quantity of ſome particular ſtock; againſt which time they ſet all their engines to work, to raiſe or lower the price of ſuch ſtock, by inventing and ſpreading falſe rumours and fictitious ſtories, in order to induce people, by theſe coined alarms, to ſell out in a hurry, and conſequently cheap, if they have contracted to deliver ſtock; or, by imagined advantages, fill the proprietors with the hopes of more profit by keeping up ſtock, and ſo render it dearer, if they have ſtock to receive. The perſons who thus delude the people, and make thoſe contracts, are not in general poſſeſſed of any real ſtock; and, when the time comes that they are to receive or deliver the quantity they have contracted for, they only pay ſuch a ſum of money as makes the difference between the price the ſtock was at, when they made the contract, and the price it happens to be at, when the contract is fulfilled. And it often happens, that perſons, not worth 100 *l.* make contracts for buying or ſelling 100.000 *l.* ſtock. In the language of Exchange-alley, the buyer in this caſe is called the *bull*, and the ſeller the *bear*. The original

ginal deſign of theſe contracts was, no doubt, to render the trafficking in our ſtocks more eaſy and convenient for foreigners; who, without this expedient, would neither be able to make the advantage of the riſe and fall of ſtocks, nor create a riſe or fall as ſeems moſt to their purpoſe. The four principal times for which bargains or contracts are made, are February, May, Auguſt, and November; and theſe, in the language of 'Change-alley are called the *reſcounter ſettlings*. Foreigners generally employ merchants to tranſact buſineſs for them in the ſtocks, who, having little time for that purpoſe, depute brokers to make theſe contracts for them; who going to the alley for the purpoſe, and finding another broker who hath a commiſſion to ſell the ſame quantity of ſtock which he hath orders to purchaſe, the price is agreed on; and the one notes in his book, *Bought of Jeremiah Sly* 5000 l. 3 *per cent. annuities, for May.*—and the other, *Sold to Jonathan Trap* 5000 l. 3 *per cent. annuities, for May.*—Thus is the bargain finiſhed, but no principal or proprietor appears in the treaty; and this gives occaſion, under the ſanction of tranſacting for foreigners, to brokers and jobbers in the ſtocks to buy and ſell for themſelves, without any property in, or out of the funds; and, perhaps, without any deſign of transferring or accepting the funds they buy or ſell, but, at moſt, only paying or receiving the odds at the time of ſettling.—— Hence, for the different purpoſes of the jobbers, the bulls and the bears, one thing will be propagated in the city and another at St James's.—The miniſtry are turned topſy turvey in whiſpers, and ſet by the ears in private letters from the Hague. —Invaſions, rebellion, flat-bottomed boats, ſchemes, ſecret negotiations, and all the other chimeras that falſe hopes or fears, or rather an unaccountable ignorance and credulity, render ſubſervient to the purpoſes of ſtockjobbing.

This ſpecies of deluders, although they are by far the moſt numerous body, would loſe much of their influence. if they were not countenanced and abetted by thoſe very people, whoſe intereſt, did they know it, ſhould direct them to a conduct quite the contrary; I mean thoſe gentlemen of rank and fortune, who have very conſiderable properties in the funds. Thus, for inſtance, a gentleman, who, perhaps, enjoys a conſiderable poſt in the nation, and, for that reaſon, may be ſuppoſed to have the earlieſt intelligence of all events that have any influence upon the ſtocks, and whoſe honour will not admit the ſuppoſition of his propagating a falſehood; in order to ſettle a great account in the alley to his advantage, ſhould he report a piece of news to be true, which had never exiſted

exiſted any where but in his own brain, and retail it in whiſpers by his emiſſaries; ſhould he go further ſtill, and confirm this relation by an actual ſale or purchaſe of *L.* 1000 ſtock at a low or high price, as he intends to ſell out or purchaſe the unthinking proprietors are eaſily catched by ſo ſtrong a bait, and he gets his purpoſe effected before the cheat can be diſcovered.

Should this man have a principal command in the army, or in the fleet, he hath it in his power to do the public a double prejudice; firſt, by neglecting his duty, in order to favour his account in the alley, he makes the evil real, which in the firſt caſe was only imaginary; and ſecondly, this evil hath not only the ſame effect on the funds, but as it can meet with no real contradiction, it muſt be conſequently more laſting.

The unaccountable artifices, deluſions, and fictions made uſe of to promote the intereſt of jobbers and gameſters at home, are not a little ſupported by foreigners, who have properties in our funds.——When they have given orders for making the contracts we have already taken notice of, and have received advice of the purchaſe, it is then their buſineſs to ſet every engine to work, to turn the ſcale in their favour by the time of ſettling the account. Hence thoſe private letters, which are ſo often ſhown upon 'Change, and which the creatures of theſe foreigners improve to every purpoſe of hurting their country.——Theſe letters paſs from the alley to the news-writer; and not only are thoſe concerned in the ſtocks amuſed to their prejudice, but the whole nation deluded by hopes, or alarmed by fears, concerning events which never did, nor poſſibly ever will happen.

It is likewiſe the misfortune of many young merchants and tradeſmen decoyed by deſigning brokers, and elated with the hopes of being rich in an inſtant, to be drawn in pretty deep in the adventures of the alley, and ignorant of their true intereſt, and unacquainted with jobbing politics, they become dupes to their own ſervants, the brokers, by retailing their fictions in all the coffee-houſes they frequent, and never give over acting, till loſs of fortune, of credit and ſympathy, cloſe the ſcene. Theſe are the cauſes of the fluctuations in the funds; and if we only conſider the variety of ſtocks, and the different events which may affect them, it will be eaſy to figure the confuſion, the uproar, and the ferment that continually prevails in the alley, and how unlikely it is that buſineſs can be tranſacted there with decency or order, while the proprietors in the funds ſuffer themſelves to be duped and bubbled by ſuch gentlemen as have been above deſcribed.

A TABLE, exhibiting at one view the intrinsic value per cent. of the several public funds, and the proportion they bear to each other, by which any person may know which it will be most advantageous to purchase, and what proportion such purchase bears to the value of landed estates and life annuities.

3 *per cent.* at 60.	3½	4	4½	5	5½	6	*Years purchase* 20.	*Annual interest* £5 *per cent.*
	70	80	90	100	110	120		
61½	71¾	82	92¼	102½	112¾	123	20½	4 17 6
63	73½	84	94½	105	115½	126	21	4 15 2
64½	75¼	86	96¾	107½	118¼	129	21½	4 13 0
66	77	88	99	110	121	132	22	4 10 10
67½	78¾	90	101¼	112½	123¾	135	22½	4 8 10
69	80½	92	103½	115	126½	138	23	4 6 11
70½	82¼	94	104¾	117½	129¼	141	23½	4 5 1
72	84	96	108	120	132	144	24	4 3 4
73½	85¾	98	110¼	122½	134¾	147	24½	4 1 7
75	87½	100	112½	125	137½	150	25	4 0 0
76½	89¼	102	114¾	127½	140¼	153	25½	3 18 6
78	91	104	117	130	143	156	26	3 16 11
79½	92¾	106	119¼	32½	145¾	159	26½	3 15 5
81	94½	108	121½	135	148½	162	27	3 14 0
82½	96¼	110	123¾	137½	151¼	165	27½	3 12 8
84	98	112	126	140	154	168	28	3 11 4
85½	99¾	114	128¼	142½	156¾	171	28½	3 10 2
87	101½	116	130½	145	159½	174	29	3 9 0
88½	103¼	118	132¾	147½	162¼	177	29½	3 7 9
90	105	120	135	150	165	180	30	3 6 8
91½	106¾	122	137¼	152½	167¾	183	30½	3 5 7
93	108½	124	139½	155	170½	186	31	3 4 7
94½	110¼	126	141¾	157½	173¼	189	31½	3 3 5
96	112	128	144	160	176	192	32	3 2 6
97½	113¾	130	146¼	162½	178¾	195	32½	3 1 6
99	115½	132	148½	165	181½	198	33	3 0 7
100½	117¼	134	150¾	167½	184½	201	33½	2 19 8
102	119	136	153	170	187	204	34	2 18 10

ILLUSTRATION *of the preceding table.*

Suppoſe 3 *per cent.* annuities may be purchaſed at 84 *per cent.* and India ſtock at 140;—in the column of 3 *per cent.* find 84, and oppoſite thereto, in the column of intereſt, it will be found to produce 3 *l.* 11 *s.* 4 d.;— in the column of 6 *per cent.* the dividend on India ſtock ſtands 168, which ſhews, that when 3 *per cent.* give 84 *per cent.* India ſtock ought to give 168; ſo that to purchaſe India ſtock is in this caſe by 28 *per cent.* a better bargain than 3 *per cent.* annuities, unleſs ſome allowance be made for the difference of the ſecurities, as it is not certain that the company will always be able to give 6 *per cent.* for an annual dividend out of the profits of their trade.

SECT. VI. *Some of the laws relating to ſtockjobbing.*

7. *Geo.* II. *c.* 8. All contracts which ſhall be entered into upon which any premium ſhall be given for liberty to deliver or receive, accept or refuſe, any public ſtock or ſecurities, ſhall be void and null, and all premiums upon ſuch contracts or wagers ſhall be reſtored to the perſon who ſhall have paid them, who within ſix months from the making of ſuch contract, *&c.* may ſue for the ſame with double coſts; and it ſhall be ſufficient for the plaintiff to allege, that the defendant is indebted to him, or hath received to his uſe the money or premium ſo paid, whereby the action accrued, according to the form of the ſtatute, without ſetting forth the ſpecial matter; and a bill in equity may be preferred, for diſcovering any contract or wager, and the premium given, which the defendant ſhall be obliged to anſwer upon oath.——To enter into ſuch contracts, and neglect ſuch proſecution, incurs a penalty of *L.* 500, to which penalty the writer of ſuch contract, or negotiator, is liable. To make up a difference of that kind without a public action, incurs a penalty of *L.* 100; and no perſon who ſhall ſell ſtock to be delivered and paid for at a certain day, if it be refuſed or neglected to be paid for, ſhall be obliged to transfer the ſame; but it ſhall be lawful for ſuch perſon to ſell ſuch ſtock to any other, and to receive or recover from the perſon who contracted for the ſame, the damage which ſhall be ſuſtained; and any perſon who ſhall buy ſtock to be accepted and paid for on a future day, and which ſhall be refuſed, or neglected to be transferred, may buy the ſame quantity of ſuch ſtock of any other perſon, at the

the current market price, and recover and receive from the firſt ſeller the damage ſuſtained.——All contracts made for the buying or transferring of ſtock, whereof the perſons, in whoſe behalf the contract ſhall be made to transfer the ſame, ſhall not at the time of making ſuch contract be actually poſſeſſed of that ſtock in their own right, or in the name of truſtees, ſhall be void; and every perſon in whoſe behalf, and with his conſent any contract ſhall be ſo made to ſell ſtock, of which ſuch perſon is not actually poſſeſſed, ſhall forfeit the ſum of *L.* 500, one moity to the crown, and the other to him who ſhall ſue for the ſame; and any broker or agent who ſhall negotiate ſuch contract, and ſhall know that the perſon in whoſe behalf the contract ſhall be made is not poſſeſſed of the ſtock, ſhall forfeit *L.* 100, to be divided betwixt the crown and the proſecutor.——Every broker or perſon who ſhall act as a broker in the buying or ſelling of ſtocks, ſhall keep a broker's book, in which he ſhall enter all contracts that he ſhall make, on the day of the making ſuch contracts, with the names of the principal parties, as well buyers as ſellers, and ſuch broker who ſhall not keep ſuch book, or ſhall wilfully omit to enter any contract, for every ſuch offence ſhall forfeit *L.* 50, to be divided betwixt the crown and the proſecutor.

Variety IX. FACTORAGE.

FActors are merchants agents, reſiding abroad, conſtituted by letters of attorney to act for their conſtituents.

Supercargoes are employed by merchants to go voyages, and diſpoſe of cargoes to the beſt advantage. Storekeepers frequently get the name of ſupercargoes, who have the chief management of ſtores abroad, in vending goods, and making remittances.

The premium, or allowance made to a factor for his trouble in purchaſing goods, or putting off conſignments, *&c.* is different in different countries, and for different conſiderations, but always rated, excepting in the caſe of an annual ſalary, at ſo much *per cent.*

In computing the allowance, or commiſſion due to factors, multiply the ſum upon which the commiſſion is to be charged by the rate *per cent.* and divide the product by 100, and the quotient gives the anſwer.

Ex. 1. Bought goods for account of A. B, which, with charges of package, porterage, lighterage, *&c. per* invoice,

amount to *L.* 5756, 11 *s.* 6 *d.*; what commiſſion is to be added at $2\frac{1}{2}$ *per cent.*

5756.575
$2\frac{1}{2}$

11513.150 =2 *per cent.*
2878.2875=$\frac{1}{2}$ *per cent.*

143.914375=*L.* 143 18 $3\frac{1}{4}$.

Note 1. In dividing by 100, there is no occaſion at any time to note the diviſor, but ſimply to point off two figures, or places extraordinary for decimals.

Note 2. Queſtions of this nature may frequently be anſwered more expeditiouſly by practice, eſpecially when the given rate is any even part of a pound.

The laſt example reſumed.

L. 2·10 *per L.* 100=6 *d.*
Per L. =40.

40)5756.575

143.914375 as before.

Ex. 2. Negotiated bills for A. B. to the amount of 4785 *l.* 19 *s.* what commiſſion ought I to charge, at $\frac{1}{2}$ *per cent.*?

Here $\frac{1}{2}=\frac{1}{5}$ of $2\frac{1}{2}$.
Therefore, 4|0)478|5.95

5)119.64875 at $2\frac{1}{2}$ *per cent.*

23.9.975 =*L.* 23 18 7 at $\frac{1}{2}$ *per cent.*

Ex. 3. A. B.'s ſales, *per* the Diamond, amount to *L.* 4849, 11 *s.* 6 *d.* what is the commiſſion at 3 *per cent.*?

$2\frac{1}{2}+\frac{1}{2}=3$ Therefore, 4|0)484|9.575

5)121.239375 at $2\frac{1}{2}$
24.2478 at $\frac{1}{2}$

145.487175 at 3 *per cent.*

Ex. 4. My factor at Jamaica charges me 5 *per cent.* commiſſion

miſſion on my account of ſales, amounting groſs to 5784 *l.* 18 *s.*; what will his commiſſion amount to?

2|0) 578|4.9

289.245 = *L.* 289 4 10½.

Ex. 5. What commiſſion is due on a bill of ſales, amounting to 7418 *l.* 14 *s.* at 4 *per cent.*?

4 *per cent.* is $\frac{1}{20}-\frac{1}{5}$.

Therefore, 2|0) 741|8.7

370.935 at 5 *per cent.*
74.187 at 1 *per cent.*

296.748 at 4 *per cent.* = *L.* 296 14 11 ½.

Ex. 6. Drawn on my correſpondents at London for 5745 *l.*; what premium ſhould I have at 1¼ *per cent.*?

1 *per cent.* = $\frac{1}{100}$) 5745

$\frac{2}{8}=\frac{1}{4}$	4) 57.45	at 1 *per cent.*
$\frac{1}{8}=\frac{1}{2}$ of that	2) 14.3625	at $\frac{2}{8}$
	7.18125	at $\frac{1}{8}$
	78.99375	

Abſtracts from the laws of England relating to factorage.

1. If a factor by his commiſſion is impowered to diſpoſe of his employer's goods as if they were his own, the factor's actions will be excuſed, though to his employer's loſs, unleſs it can be proved, that, in ſimilar circumſtances, he hath done more for himſelf than he hath done for his employer. *Bulſtrode*, 103.

2. A factor cannot ſell his employer's goods but for ready money, without a particular order, or commiſſion; in which caſe, though the purchaſers ſhould afterwards become bankrupt, provided they were in good credit at the time of the purchaſe, and the factor done his duty in recovering payment, he is not accountable, excepting by expreſs ſtipulation, upon the account of an extra commiſſion *Hill*, 1708 2 *veru.* 638.

3. If a factor ſhould die before the debts ariſing from the ſales

ſales of his employer's goods are recovered, however bad the circumſtances of the defunct's affairs may be, the money is to be paid to the employer, after deduction of commiſſion, and not retained by the executors or adminiſtrators, to be applied for extinction of any other of the defunct's debts. *Hill*, &c.

4. If a factor give time for payment of money, contracted on the ſale of his employer's goods, which being elapſed, and no payment made, he, notwithſtanding, ſell the debtor goods of his own for ready money, who ſome time after proves inſolvent; the factor, for the ſake of his own credit, ſhould indemnify the employer, but he is not compellable by the common law. *Molloy*.

5. If a factor makes ſales, and does not adviſe his employer, the factor, in that caſe, is anſwerable for the conſequences. *Lex mer*.

6. If a factor, by commiſſion, purchaſe goods with his employer's money, or credit, and, on account of a ſudden advance, diſpoſe of them for his own behoof; the merchant, in this caſe, hath action againſt the factor for damages and a fraud. *Lex mer*.

7. If a factor purchaſe above the price, or not of the quality limited by his commiſſion, his employer may diſclaim the goods, as he may likewiſe do if they are ſhipped to another port than he had ordered them; but, in the caſe of a ſudden advance, if the factor fraudulently miſconſtrue the orders, then the employer hath action of damages. *Lex mer*.

8. If a merchant ſend goods to a factor for a fund of credit, and in conſequence, ſome time after, a month for inſtance, draws on him for a certain ſum, which the factor, having effects in his hands, accepts; if, before the bill becomes payable, the merchant ſhould be bankrupt, and the goods in the factor's hands ſeized; in this caſe, it hath been found, the factor muſt anſwer the bill, and ſue as a common creditor for what he can recover of the contents. *Molloy*, 442.

OBSERVATIONS.

When a factor hath bought or ſold, purſuant to orders, he ought immediately to adviſe his principal, leſt his former orders ſhould be contradicted. Frequency and punctuality in writing,

writing, a proper knowledge of the value, fall, and riſe of goods, both at home and abroad, diligence in executing orders, and honeſty and punctuality in giving a faithful account, are the true and infallible means of raiſing and ſecuring the reputation of a factor.

2. When a merchant ſends out an invoice to his factor, he generally charges it with 5, 10, or 12 *per cent.* according to circumſtances; in one caſe that the factor may not be acquainted with all the profits, but, particularly, with regard to a ſupercargo, that he may ſell at ſo much profit upon the invoice.

3. There are no particular laws or regulations, that I have ſeen, in regard to the price of commiſſion. In Jamaica and in moſt parts of America it runs about 10 *per cent.* for ſales and remittances; in Holland, Italy, *&c.* and other places nearer home, at $2\frac{1}{2}$; in ſome places on the continent, 2 *per cent.*

Variety X. INSURANCE.

INſurance is a ſecurity, or aſſurance, by means of a writ called a *policy*, to indemnify the inſured of ſuch loſſes as ſhall be ſpecified in the policy ſubſcribed by the inſurer, or inſurers, and entered in ſome particular office, as a teſtimony or voucher of the tranſaction, by which the underwriters oblige themſelves to make good and effectual the property inſured, in conſideration of a certain premium. at a ſtipulated rate *per cent.* which varies according to the riſk, to be immediately paid down, or otherwiſe ſecured, according to the tenour of the agreement. In caſe of loſs, the underwriters can retain a certain diſcount, generally 2 *per cent.* and only pay what is called the *ſhort recovery.*

Caſe 1. When the premium at a certain rate *per cent.* for inſuring a given ſum is required, the operation is the ſame as in factorage.

Ex. 1. Inſured at Hamilton's office, the value of 574 *l.* at $7\frac{1}{2}$ *per cent.*; what is the premium?

20)574

20)5714

2)28.7 for 5 *per cent.*
14.35 for 2½ *per cent.*

43.05 for 7½ = *L.* 43, 1 *s.*

Ex. 2. Insured with Dunlop, Glen, and Peters, the value of 3768 *l.* at 14½ *per cent.*; what is the premium?

10)3768

5)376.8 for 10 *per cent.*
75.36 for 2 *per cent.*
4)75.36 for 2 *per cent.*
18.84 for ½ *per cent.*

546.36 for 14½ *per cent.* = *L.* 546 7 2⅖.

Ex. 3. Insured at the Sun-fire office, on my tenement in the Gallowgate, the value of 748 *l.* 19 *s.*; what sum must I pay yearly, at 2 *s. per* 100 *l.* to keep the policy in force?

L. 748.95
.1

.74895
20

14.97900
12

11.74800

Case 2. When the short recovery is required find the discount as the premium was found in the last case, subtract it from the given sum, and the remainder is the short recovery.

Exam. 1. Discount is allowed at 2 *per cent.* in recovering *L.* 1000 insured, what is the short recovery?

50) 1000
20 discount.

980 short recovery.

Exam.

Exam. 2. Diſcount is allowed at $2\frac{1}{2}$ *per cent.* in recovering *L.* 500 inſured, what is the ſhort recovery?

40) 500
12 10 diſcount.

487 10 ſhort recovery.

Caſe 3. To find the ſum neceſſary to be inſured, when the adventurer would cover, or make good his outſet in caſe of loſs; that is, to recover from the underwriters the whole value at riſk; to the rate *per cent.* premium add the ordinary diſcount, and ſubtract that ſum from *L.* 100 for the firſt term, let *L.* 100 be the ſecond, and the value at riſk the third, then will the fourth proportional be the anſwer.

Exam. 1. It is required to cover *L.* 500, premium 8 *per cent.* and 2 *per cent.* diſcount in caſe of loſs?

L.
100—8+2=90 : 100 :: 500
100.

90) 50000
L. 555 11 $1\frac{1}{9}$

Note, It is plain, that when we want to recover *L.* 90, we muſt in this caſe inſure *L.* 100; therefore to recover *L.* 500, we muſt inſure *L.* 555. 11 *s.* $1\frac{1}{9}$ *d.*: for when 10 *per cent.* for diſcount and premium is deducted, we ſhall have *L.* 500 remaining nett.

For 555 11 $1\frac{1}{9}$ inſured at 8 *per cent.*
44 8 $10\frac{2}{9}$ premium to be deducted,

511 2 $2\frac{2}{9}$ remains.
11 2 $2\frac{2}{9}$ 2 *per cent.* diſcount to be deducted.

500 0 0 firſt outſet.

Exam. 2. It is required to cover *L.* 575, premium $14\frac{1}{2}$ *per cent.* 2 *per cent.* diſcount in caſe of loſs?

100
$14\frac{1}{2}+2=16.5$

83.5 : 100 :: 575
100

83.5) 57500. (688.62 &c.
5010

7400
6680

7200
6680

5200
5010

1900
1670

230

Case 4. To find the amount of insurance of a voyage out and home. Deduct the premium from the short recovery; then say, As the remainder is to the premium, so is the amount of the first insurance, together with the outset, to the insurance of the voyage home, which being added to the insurance outwards, makes the total insurance.

In the first example of the last case the premium was = L. 44 8 $10\frac{2}{3}$
500 0 0 outset.

90 : 8 :: 544 8 $10\frac{2}{3}$
4

5) 2177 15 $6\frac{2}{3}$

9) 435 11 $1\frac{1}{3}$

Insurance home,	48	7	$10\frac{2}{3}$
Insurance out,	44	8	$10\frac{2}{3}$
Total insurance,	92	16	9

To

To find what will cover this ſum homewards, it will be as in the laſt caſe.

			L.	s.	d.
90	: 100	::	544	8	$10\frac{2}{7}$
					10
			9) 5444	8	8
			L. 604	18	$8\frac{8}{9}$ to be inſured home.

After the ſame manner may the inſurance on a triple voyage be computed, by making another operation founded on the foregoing.

			L.	s.	d.
Thus 9	: 8	::	592	16	9
					4
			5) 2471	7	0
			9) 474	5	$4\frac{4}{7}$
			52	13	$11\frac{5}{7}$ inſurance home.
			92	16	9 outwards to different ports.
			145	10	$8\frac{1}{7}$ total inſurance.

Caſes of inſurances, and the method of ſettling them.

Caſe 1. Sir Alexander Grant *contra* William Innes, ſettled at London 15th of May, 1759.

The ſhip the Prince of Orange being fitted out and victualled at Waterford, was ſent to Jamaica to take in her cargo, which ſhe accordingly did, and on the 2d December 1757 ſailed from Montego bay in the ſaid iſland, without convoy, and on the 2d February 1758 was taken by a French privateer.

Between the 11th and the 13th of the ſame February, the plaintiff cauſed to be inſured by different perſons the ſum of *L.* 1600, at and from Jamaica to London upon the ſaid ſhip and freight, beginning the adventure from, and immediately following the ſhip's arrival at Jamaica, and ſo to continue until ſhe ſhould arrive at London. About the 12th February 1758 the ſhip was retaken by a Britiſh privateer, called the Britannia, Capt. Dobſon, who became entitled to half the nett proceeds; the plaintiff applied to the recaptor's agent, and deſired he might have the direction of ſelling the ſhip and cargo for the benefit of the concerned, but was refuſed;

whereupon two brokers were mutually agreed to by all parties to ſell and diſpoſe of the ſhip and her cargo.

The ſhip and cargo were accordingly ſold by public auction, with the mutual conſent of the plaintiff, inſurers, and recaptors, and one half of the nett proceeds was paid to the plaintiff, and the other half to the recaptor: and in the account delivered by the broker, the plaintiff was allowed for the ſhip's freight 1322 *l.* 8 *s.* 6*d.*; in which event, though he had formerly declared for a total loſs, he now only claimed a partial or average loſs.—The ſhip and her cargo being thus ſold by public auction, the plaintiff delivered in all his vouchers to the policy-broker, to make up the account, and ſtate the loſs for the examination of the inſurers; and it was accordingly ſtated as follows.

	L.	*s.*	*d.*	*L.*	*s.*	*d.*
The Prince of Orange coſt at private ſale - - - -	550	0	0			
Amount of the outſet by the ſhip's books, - - -	522	2	2			
Premium of *L.* 1155 to cover the above from London to Waterford, at 5 guineas *per cent.*	60	17	3			
	1132	19	5			
Proviſion for the ſhip's uſe at ditto,	110	9	1			
	1243	8	6			
Deduct freight from London to Waterford, - -	121	0	0			
	1122	8	6			
Deduct return of 2½ *per cent.* commiſſion on *L.* 1155, - -	28	17	6			
	1093	11	0			
Premium on *L.* 1190 from Ireland to Jamaica, at 6 guineas *per cent.* to cover *L.* 1093, 11 *s.*	75	4	6			
	1168	15	6			
Deduct freight from Ireland to Jamaica, - - - -	290	14	0			
	878	1	0			
Premium on *L.* 1320 from Jamaica to London, to cover *L.* 878, 1 *s.* at 30 guineas *per cent.* -	416	0	6			
	1294	1	6			
Total amount of the freight,	1322	8	6			

	L.	s.	d.	L.	s.	d.
Brought over, - -	1322	8	6			
Deduct the portage-bill and charges in the river, which may be about, - -	422	8	6			
	900	0	0			
Premium of *L.* 1350 to cover *L.* 900 at 30 guineas *per cent.*	425	5	0			
				1325	5	0
So that there might be insured on the ship, - -	1320	0	0			
And on the freight, -	1350	0	0			
In all, - -	2670	0	0			
Half the nett proceeds of the ship and freight, - -				940	11	1
From which deduct half the crew's wages home, -				138	11	3
			Nett,	801	19	3

2670 at 98 *per cent.* *L.*	2616	12	0
Received -	801	19	10
	1814	12	2

Then 2670 : 1814 :: 100 : *L.* 67-18-9, being the average-loss claimed by the plaintiff.

Defendant's Objections.

It is understood, that the practice among merchants is, to insure no more on ship and freight than the sum it would require to bring her on an equality, whether she arrive or not; but when neither are valued, to ascertain whether a merchant chuses to have a profit in view by her arrival or capture, and for which, when valued, he pays a certain premium, it seems natural, that the insured means only to be secured and reinstated in his real property, into which the insurers have a right to inquire, and to see that the account is properly stated. And it must be owned, that the wear of a ship greatly reduces her value, which the freight again answers, but with heavy charges; therefore ship and freight are the same; or, if they are separated, it depends much on fancy; wherefore, in this case, the owners should only have insured as under.

The

	L.	s.	d.
The value of the ſhip at Jamaica being	878	1	0
Required only inſurance on L 1350 on ſhip and freight, at 30 guineas *per cent.*	425	5	0
	1303	6	8

If a total loſs had happened, that L. 1350 ſecured the owners at 98 *per cent.* in L. 1323.

As ſhe was taken, *&c.* they received for half ſhip and freight,	801	19	10

L. L. s. d. L. L. s.

Then 1350 : 561 6 2 :: 100 : 37 2; which average-loſs was offered to be paid by the defendant.

Some urge it to be the cuſtom to inſure nett freight, as well as the value of a ſhip; and it is too general a cuſtom alſo to miſtake what nett freight actually is, or rather impoſſible to calculate exactly, what a ſhip and freight will yield in the middle of a voyage: therefore, it is incumbent on an owner to pleaſe himſelf, and declare it by a valution of both; but if he does not, and leaves all open, it is to be preſumed, he means only to ſecure his real property, and inſurers can never be liable to pay the loſs on an accidental or imaginary profit, in caſe of a total loſs; while the aſſured, in the event of a ſafe arrival, and that by heavy charges, ſuch as thirty guineas to ſailors for the run home, his ſuppoſed nett freight, or profit, does not yield to his expectation, can have recourſe upon the inſurers for a return of premium, by complaining of his miſtake after the ſhip's arrival. Wherefore all inſurances left open, and not valued, are intended only to ſecure the real original property. But as there are facts in the preſent caſe, let it be ſuppoſed, the aſſured or owner meant to make profit, which is granting a contradiction on an unvalued policy; by inſuring his freight at a high rate, his claim for return of premiums would be founded on the following ſtate, by proving his intereſt at the higheſt, it now turns out to be at the end of the voyage.

Suppoſe L. 2670 had been inſured without valuing the ſhip and freight, and the ſhip arrived ſafe, the aſſured could have demanded a return of premium, by ſtating his account thus.

Amount

				L.	s.	d.
Amount of the ſhip's freight,	-	-		1322	8	6
Ditto of ſhip ſold at	-	-	-	720	0	0
Total value,	-			2042	8	6
Coſt at Jamaica,	-	-	L. 878 1 0			
Premium on L. 1350 ſhip and freight,			425 5 0			
Portage bill,	-	-	438 8 9			
				1741	14	9
Nett freight or profit to be inſured at L. 286, 14 s. to bring it home,		-	-	300	13	9
Inſurers debtors to premium of L. 2670, at 30 guineas,	-	-	-	841	1	0
By inſurance on L. 1350 0 0			425 5 0			
By dº on nett freight, 286 14 0			90 6 3			
				515	11	3
	1636 14 0					
Sum over-inſured,	1033 6 0		-	325	9	9
L. 2670 0 0			-	841	1	0
The above nett freight at Jamaica,			-	300	13	9
Deduct coſt of inſurance on L. 286, 14 s.			-	90	6	3
When brought home to London yields nett				210	7	6

Note, Inſtead of adding the premium to a ſuppoſed profit on ſhip and freight at Jamaica, the premium thereof muſt always be deducted, and leſs inſured to make it a real value.

PROOF.

If ſhe arrive ſafe,			L.	s.	d.
She ſold at, or was worth	-	-	720	0	0
Her freight turned out at	-	-	1322	8	6
			2142	8	6
Coſt at Jamaica, -	L. 878 1 0				
Inſurance on L. 1638, 14 s.	515 11 3				
Portage-bill, - -	438 8 9				
			1832	1	0
Nett profit,			210	7	6

			L.	s.	d.
If there had been a total loſs,					
L. 1636, 14 s. at 98 *per cent.* would pay			1603	19	9
Coſt at Jamaica,	L. 878	1 0			
Inſurance premium,	515	11 3			
			1393	12	3
Nett profit,			210	7	6
As ſhe was taken and retaken,					
L. 1636, 14 s. at 98 *per cent.*			1603	19	9
By nett proceeds of half ſhip and freight,			801	19	10
The inſurers muſt then have paid			801	19	11
Nett proceeds of half ſhip and freight,			801	19	10
			1603	19	9
Coſt at Jamaica,	L. 878	1 0			
Ditto premium,	515	11 3			
			1393	12	3
Nett profit,			210	7	6

Note, The underwriter in this calculation does not ſtudy the minuteſt exactneſs, but ſlumps ſmall things to bring out his proof.

As certainly every man means his true intereſt in all his operations in trade, therefore the above ſtate proves proper calculations; as whether a ſafe arrival, a total loſs, or a capture and re-capture had happened, the profit, or nett freight, turns out equally the ſame. Wherefore, in all inſurances of ſhip and freight, both, or either, left general and not valued, the aſſured can calculate in the above manner for a return of premium; as alſo the inſurers from paying too much. If the inſurers were to pay, reſpecting the caſe in queſtion, on the imaginary ſum of 2670 *l.* the aſſured would not only gain L. 896 : 13 : 4, by the capture and recapture, an accident, but ſaves alſo L. 115 : 6 : 9, they would have loſt had the ſhip arrived ſafe, without the leaſt chance of a reciprocal advantage to the inſurers by any accident.—If cuſtom is pleaded to a contrary practice reſpecting freight, it hath no relation to an inſurance on ſhip and freight; becauſe, if a high valuation is made and inſured on the one, ſo much the

leſs ought to be done on the other. This cauſe coming on to be heard, and the plaintiff's witneſſes proving, that it was cuſtomary in the city of London for an owner of a ſhip to cover his intereſt both in ſhip and freight, by inſuring the ſhip and freight, and the premium paid for inſuring the ſame, the underwriter taking the premium, in caſe the ſhip arrives ſafe, the jury gave a verdict for the plaintiff.

Cunningham's law of bills, &c.

Caſe 2. Shewing how a particular average was calculated at Hamburg.

Aſſurance made for account of Mr. C—s C——o de C—o, from Liſbon hither, for the ſum of 3000 marks Banco, upon 10 cheſts ſugar, ſhipped by him on board the Antonetta galley, Capt. Thormay, which, according to the bill of lading and invoice, amount to 826 and 512 mil. and are valued in the policy at 4 marks *per* milree, without premium.

Is, marks,		3306	1
Premium, at 7½ *per cent.*		239	11
Premium upon ditto, at 7½ *per cent.*		17	5
	Marks,	3563	1
Whereupon hath been inſured, marks,	3000		
and left uninſured,	563 1		
	3563 1		

The above ten cheſts have, as *per* invoice, weighed in the country neat 375 arrobes, 22 lb. which at 30 lb. *per* arrobe, make 11,272 lbs. of our weight, and amount, at 9½ *d.* with 8⅓ *per cent.* diſcount, to marks 2998·7.

But as the above ten cheſts proved damaged by ſea-water, they were ſold, by order of the inſurers, to the beſt bidders, and produced marks

		2514	2
Deduce 8⅓ *per cent.* diſcount,		200	8
		2313	10
Which being deducted from		2998	7
Makes the loſs		684	13
To which muſt be added for extra-charges,			
To the captain, for general average of marks 2500, at marks 4 : 3 : 6,	Marks,	105	8
Carried forward,		790	5

Brought forward, -		790 5
To the notary, for atteſtations, &c. -		4 8
To brokerage of 5 cheſts, ſold at public ſale,		7 8
Cooperage and porterage, - -		2 8
	Marks,	804 13
Deduct agio of marks 120, at 130 *per cent.*		27 11
The whole loſs - - - -		777 2

Which being divided on the value of 300 marks banc, affects every 100 marks with marks 25-14 6.

This account was not objected to, and ſhews the equity of the inſurers; who might have ſtated as under:

5 cheſts of ſugar damaged, weighed at Liſbon, as *per* invoice, 186 arr. 22 lb. which, at 30 lb. *per* arr. make in Hamburgh 5602, at 9½ *per cent.* Marks, 1621 1

Deduct 8⅓ *per cent.* diſcount 129 4

1491 13

Note, When tare allowance for good weight and ſweepings is deducted, an arrobe of ſugar from Liſbon will produce only 28½ lb. Hamburgh.

CHARGES.	Marks.		
Freight, 14 marks *per* cheſt, -	70	0	
Ordinary average, - - - -	7	0	
Cuſtom, at 18½ ſpetus *per* cheſt, with 30 *per cent.* agio, - -	7	8	
Primage and ſtader-duty - -	5	10	
Admiralty of marks 700, with 15 *per cent.* agio, - -	8	1	
Lighterage, porterage, and cooperage,	3	12	
Brokerage at 1½ - -	7	8	
Marks 109 7, at 130 *per cent.* agio,	84	4	
Commiſſion, at 2 *per cent.* -	29	13	
			114 1
Had there been no average, they would have produced - - -			1377 12
But, as the ſame were damaged, they yielded but - -	978	1	
Deduct 8⅓ *per cent* -	78	0	
	900	1	
Carried forward, -			1377 12

Brought forward,				1377	12
Ordinary charges as above,	84	4			
General average,	105	8			
Notary and commiſſion,	22	8			
			212 4	687	13
				689	15

Conſequently they yielded leſs.

Which being proportioned upon the above-mentioned ſum of marks 3563-1, according to the valuation in the policy, but which, by an exact computation, comes to marks 3564-8. Hence $19\frac{7}{10}$ marks muſt be paid *per cent.*

Wherefore there muſt be paid by the underwriters on 3000 marks inſured, 580 8

By the proprietors, for what was not inſured, *viz.* 564 8 109 4

3564 8 689 12

Caſe 3. Shewing how an account was ſettled where the ſhip and cargo was ranſomed, having been partly inſured at different offices, and partly riſked by the proprietors.

A. B. Freights a ſhip out and in for a voyage to the Weſt Indies, and by the charter-party was obliged to make payment to the owner of the ſhip in a certain ſum for every gallon of rum or cwt. of ſugar ſhe carried inwards, provided ſhe landed ſafe, and likewiſe to fill her quite full of one or both theſe ſpecies of goods.

A. B. accordingly freights her outward with goods to the value of	L. 1963	16	6
Takes goods from C at a certain freight, valued at	102	4	2
from D at ditto to the value of	101	15	1
and the ſhip was valued at	512	4	6
Total value,	2680	0	3
Of this cargo A. B. covers at London at 20 guineas *per cent.*	231	0	0
And covered and riſked together the remainder at 12 guineas *per cent.* at Glaſgow and Edinburgh,	1732	16	6
The value of the ſhip with C and D's goods were likewiſe covered at the ſame rate,	716	3	9
Total,	2680	0	3

The ſhip proceeds on her voyage outwards, and was unluckily taken by a French privateer, who returned her with the cargo for a ranſom of 1409 *l.* 15 *s.* 4 *d.* When the ranſom came to be ſettled, it was pled by the underwriters, that A. B. being a proprietor for the freight, he ought accordingly to be liable in a proportion of the ranſom agreeable thereto; but when the caſe was adviſed, it was found, that as A. B. paid no freight for goods ſhipped outward, there was no real property to inſure, nor could it be a charge upon the cargo; that inſurances are only intended to procure to the proprietors of ſhips and cargoes their original coſt, and no more can be ſecured, unleſs by a ſpecial agreement with the underwriters ſpecified in the policy, in which caſe only profits may be inſured. For had the freight been payable in the Weſt-Indies, there was ſomething in this caſe riſked; but as there was no freight payable but in the event of the ſhip's arrival at Clyde, there was ſurely in this caſe no inſurance to be made by A. B.; wherefore the loſs was calculated and charged as under, which was admitted to be right by all parties.

To cover *L.* 231 at London, premium 20 guineas, 2 *per cent.* diſcount.

77 : 100 :: 231 : 300 covered property.

To cover the remainder at Glaſgow, 12 guineas premium, diſcount 2 *per cent.*

L.	*s.*		*L.*	*s.*	*d.*	*L.*	*s.*	*d.*	
85	8	: 100 ::	1732	16	6	: 2029	1	4¾	covered property at Glaſgow.

Then to cover the ſhip and the remainder of the cargo.

L.	*s.*		*L.*	*s.*	*d.*	*L.*	*s.*	*d.*	
85	8	: 100 ::	102	4	2	: 119	13	7½	C's cov^{d} property.
85	8	: 100 ::	101	15	1	: 119	2	11¾	D's cov^{d} property.
85	8	: 100 ::	512	4	6	: 599	15	10¾	value of ſhip cov^{d}.

	L.	*s.*	*d.*
A. B. ought to have inſured at Glaſgow and Edinburgh,	2029	1	4¾
And he inſured at London	300	0	0
In all,	2329	1	4¾
Of this ſum he only inſured,	2100	0	0
So that he ſtands underwriter for	229	1	4¾

Hence

	L.	s.	d.	L.	s.	d.
Hence A's underwriters at London are accountable for	300	0	0			
At Glaſgow and Edinburgh for	1800	0	0			
He is himſelf accountable for	229	1	4¾			
				2329	1	4¾
C, or his underwriters, are accountable for				119	13	7¾
D, or his underwriters, for - -				119	2	11¾
The proprietors of the ſhip, or underwriters, for				599	15	10¾
Total covered property, -				3167	13	10¾

To proportion the ranſom according to the above ſtate,

covered property. loſs. cov. p. loſs.

First, 3167 13 10¾ : 1409 15 4 :: 100 : 44 10 1 *per cent.*

Then *L.* 300 inſured at London muſt pay,	*L.*	133	10	3
1800 inſured at Edin. and Glaſgow do,		801	1	6
229 1 4¾ riſked by A. B. ditto,		101	18	10¾
119 13 7¾ C's covered property do,		53	5	2¾
119 2 11¾ D's ditto ditto, - -		53	1	3¾
599 15 10¾ ſhip ditto ditto, - -		266	18	2¾
3167 13 10¾	Proof - -	1409	15	4

Caſe 4. Shewing in what manner the owners of goods contributed to the charges of ſalvage on the amount of their value, at the place where they were landed, more than the ſum inſured on them.

Inſurance was made in London with the London-aſſurance company for the account of a merchant in Bourdeaux of *L.* 1000 *Sterling, viz.*

L. 600 upon ¼ of the ſhip L'Orphée,

400 upon ¼ of the cargo from Bourdeaux to C. Françoiſe.

Not far diſtant from Cape Françoiſe the ſhip was chaſed aſhore by an Engliſh privateer, and ſeveral of the goods plundered; the firſt coſt whereof, according to the account delivered, amounted to 12477 livres, 16 ſols, 11 deniers, and was included in the whole cargo, which the aſſured's agent at London valued at 31675 *liv.* 12 *ſols*, 9 *den.* whereof ¼ included in the aſſurance is 7918 *liv.* 18 *ſols*, 3 *den.* exchange at 33 *d. per* ecu, - - - - *L.* 362 19 1

Premium at 15 *per cent.* - - 54 9 0

Carried forward, 417 8 1

	L.	s.	d.	L.	s.	d.
Brought forward, - -				417	8	1
And $\frac{1}{4}$ of what was plundered 3119 9 3, at $32\frac{1}{2}$ *d.* - - - - -				140	16	2
Premium at 15 *per cent.* - -				21	2	4
				161	18	6
Commiſſion of the inſurance $\frac{1}{2}$ *per cent.* -					16	2
Loſs, -				162	14	8
The ſhip's value at L. 2400 *Sterl.* at $32\frac{1}{2}$ *d. per* ecu, makes	53169	4	6			
Being damaged was ſold at Cape Françoiſe for *Liv.*	16510	0				
Deduct 25 *per cent.* for differ. in the money,	4127	10				
	12382	10	0			
	40786	14	6			
Whereof the $\frac{1}{4}$ at $32\frac{1}{2}$ *d. per* ecu makes the loſs - -				460	3	9
Paid in all for ſalvage upon the ſhip and cargo *per* account,	17302	17	4			
Whereof was deducted $\frac{1}{8}$, -	2162	17	4			
	15140	0	0			
And for difference in the money,	3785	0	0			
	11355	0	0			
$\frac{1}{4}$ whereof at $32\frac{1}{2}$ *d. per* ecu makes of loſs, - - -				128	2	9
Total loſs, - -				751	1	2

Which was demanded from the ſaid company by the aſſured's agent. But it was objected, that granting the amount of the firſt coſt of the goods to be right as ſtated, at 12477 *liv.* 16 *s.* 11 *d.* yet it appeared that they really produced 55620 *liv.* from a certificate of the goods ſaved, and account of ſales at Cape Françoiſe; and though they did not pretend to any of the profit, yet they were of opinion that the proprietors of thoſe goods ought to contribute towards the charges of ſalvage, as they had rendered more than the ſum inſured on them. The company therefore made up the account in the following manner.

Per

	Per account of ſales, Sold for			and invoice, Coſt.		
49 caſks of bacon,	*Liv.* 2017			*Liv.* 781	1	6
131 red wine 5 filled up,	25798	13	8	6130	11	7
28 white wine, 1½ filled up,	1948	2	9½	480	3	0
85 pickled meat,	4745			3407	16	0
13 pots butter,	441			180	14	4
2 caſks nails,	445			171	0	0
25 bundles pipe-ſtaves,	480			137	8	0
3 caſks tallow,	230			82	15	0
2 ditto pitch,	600			50	0	0
3 ditto vinegar,	49			15	6	6
321 ditto flour,	17271			6855	6	3
6 ditto oat meal,	971			417	15	6
3 ditto brandy,	60			27	5	8
24 deals,	100			107	5	0
7 caſks lead in bullets,	465			243	7	0
	55620			19089	2	4
The ſhip	16510					
	72130					

To cover 19089 *liv.* 2 *ſols*, 4 *den.* original coſt at 15½ *per cent.* to pay 98 *per cent.* in caſe of loſs, it will be

82 10 : 100 :: 19089 2 4 : 23138 to be inſured.

Premium of 23138 at 15½ *per cent.*	*Liv.*	3586	0 0
Prime coſt as above, - -		19089	2 4
		22675	2 4
For difference in the money add 25 *per cent.*		7525	0 0
Coſt at Cape Françoiſe, - - -		30200	2 4

Upon the above-mentioned produce at the ſale of 72130 *liv.* are to be proportioned the charges of ſalvage, being *Liv.* 17302
And to deduct ¼ inſtead of ⅛, by the former account, - 4325

12977

Which

Which chargeable on the following particulars make,

For 30200 the coſt of the goods with the premium,	*Liv.*	5433
16510 the proceeds of the ſhip,		2971
25420 profit on the goods,		4573
72130		12977

And the loſs wherewith the inſurers were chargeable amounts to as follows:

The whole coſt,	*Liv.* 31675 12 9		
Premium of 38394 *liv.* at $15\frac{1}{2}$ *per cent.*	5951 0 3		
	37626 13 0		
The whole loſs,	*Liv.*	12477	17
Premium of 15124 *liv.* to cover the above at $15\frac{1}{2}$ *per cent.*		2344	3
Charges of ſalvage, 5433			
Deduct, 1358		4075	0
So that the loſs on the cargo will be about $50\frac{1}{7}$ *per c.*		18897	0
Upon the ſhip valued at *L.* 2400 *Sterling*, exchange at $32\frac{1}{2}$ *d. per* ecu,	*Liv.*	53169	4
Which was ſold for		16510	0
Deduct for charges of ſalvage,		2971	0
		13539	0
And for difference of money 25 *per cent.*		3385	0
		10154	0
Loſs to be paid on the ſhip $80\frac{2}{7}$ *per cent.*		43015	4
		53169	4

Upon this ſtate the account was ſettled, and the London-aſſurance company did accordingly pay,

For 600 *l. Ster.* inſured on the ſhip at $80\frac{2}{7}$ *per c.*	*L.*	485	8 9
For 400 ditto inſured on the cargo at $50\frac{1}{7}$ *per cent.*		200	16 0
1000		686	4 9
Which comes ſhort of the former ſtate,		61	16 5
Amount by the agent's ſtate,		748	1 2

Caſe 5. Showing in what manner three different premiums, at three different offices, where there was a general average, a return for convoy, and an over-inſurance, were ſettled.

A. B. merchant in Glaſgow gives orders for ſhipping *L.* 2027, 5 *s. Sterl.* value of goods on board the Caledonia, C—— maſter, bound from Liverpool for Cork and Antigua; in conſequence whereof he makes inſurance on the intereſt he expected to have on board, in the following manner: He inſures at Glaſgow 550 *l.* at 15 *l.* to return 8 *per cent.* if the Caledonia departed from Cork with Weſt India convoy: he inſures on the ſame intereſt at Edinburgh 950 *l* at 20 guineas *per cent.* to return 12 *l. per cent.* for convoy from Cork; and at London he inſures on the ſame intereſt 1150 *l.* at 25 guineas *per cent.* to return 15 *l.* for convoy from Cork: which ſeveral inſurances fully covered the intereſt he expected was ſhipped on board. But after theſe inſurances were finiſhed, he is informed, that, through an unforeſeen event, ſuch as the veſſel being full, and not able to take on board the whole, that there was only ſhipped on board 1463 *l.* 15 *s.* 4 *d. Sterl.* of value, excluſive of premium of inſurance, by which means there is an over-inſurance. The veſſel proceeds on her voyage, arrives at Cork, the maſter takes ſailing-orders from the captain of the man of war, and, in conſequence of ſignals from thence, weighs anchor, is under way; but unfortunately runs aground on a ſand-bank, by which the veſſel is hurt, loſſes the benefit of the convoy, returns to Cork, where the cargo is unloaded in order to repair the ſhip's damage, and afterwards the cargo is reſhipped, and the veſſel proceeds on her voyage, and arrives ſafe; but there is a general average-loſs to be paid by the ſhip and cargo, and A. B's proportion thereof is 21 *l.* 13 *s.* 4 *d.* Iriſh, to be paid by his underwriters.

Two queſtions ariſe from this caſe.

1*mo*, How much is A. B. owing to each of the inſurance-brokers at Glaſgow, at Edinburgh, and London, for the premium allowing $\frac{1}{2}$ *per cent.* for the over-inſurance?

2*do*, What proportion of the 21 *l.* 13 *s.* 4 *d.* Iriſh of general average is to be paid by the underwriters at the above three offices in Britiſh money?

	L.	s.	d.	L.	s.	d.	
Insured at Glasgow at 15 *per cent.*	550	0	0				
Deduct premium and 2 *per cent.* discount,	93	10	0				
Remains the uncovered supposed property,				456	10	0	Glasg.
Insured at Edinburgh at 20 guineas *per cent.*	950	0	0				
Deduct 23 *per cent.*	218	10	0				
Remains the uncovered supposed property,				731	10	0	Edinb.
Insured at London at 25 guineas *per cent.*	1150	0	0				
Deduct 28½ *per cent.*	324	17	6				
Remains the uncovered supposed property,				825	2	6	Lond.
Total supposed property uncovered,				2013	2	6	

To proportion the supposed property to the real, it will be

supposed.	*real.*	*supposed.*	*real.*	
2013 2 6 :	1463 15 4 ::	456 10 0 :	331 18 7	at Glasg.
2013 2 6 :	1463 15 4 ::	731 10 0 :	531 17 7	at Edin.
2013 2 6 :	1463 15 4 ::	825 2 6 :	599 19 2	at Lond.

To cover these proportions at the different offices.

1*st*, 83 :	100 ::	331 18 7 :	399 18 4	at Glasgow.
2*d*, 77 :	100 ::	531 17 7 :	690 15 1	at Edinburgh.
3*d*, 71¾ :	100 ::	599 19 2 :	836 3 6	at London.

To find the over-insurance.

	L.	s.	d.	L.	s.	d.
There was insured at Glasgow,	550	0	0			
There ought to have been insured but	399	18	4			
Over-insured at Glasgow,				150	1	8
There was insured at Edinburgh,	950	0	0			
There ought to have been insured but	690	15	1			
Over-insured at Edinburgh,				259	4	11

There

	L	s.	d.	L.	s.	d.
There was insured at London,	1150	0	0			
There ought to have been insured but	836	3	6			
Over-insured at London, - -				313	16	6

L 21 13 4 Irish is at par *L.* 20.

To proportion which,

53	20	11	4	3	0	chargeable at	Glasgow.
53	20	19	7	3	4¼	at	Edinburgh
53	20	23	8	13	7¼	at	London.

L. 20 0 0 Proof.

Hence the account must be stated as under.

	L.	s.	d.
Premium of 550 *l.* insured at Glasg. at 15 *per cent.*	82	10	0
¼ *per cent.* on 150 *l.* 1 *s.* 8 *d.* over-insured, -	0	15	0
Gross debit, - -	83	5	0
Ded. 8 *per cent.* returns for convoy, *L.* 44 0 0			
Return of premium 7 *per cent.* for 150 *l.* 1 *s.* 8 *d.* - 10 10 1¼			
Proportion of average, - - 4 3 0			
	58	13	1¼
Nett debit at Glasgow, - -	24	11	10¼
Premium of *L.* 950 at 21 *per cent.* insured at Edinburgh - - -	199	10	0
¼ *per cent.* on 259 *l.* 4 *s.* 11 *d.* over-insured,	1	5	11
	200	15	11
Ded. 12 *per cent.* returns for convoy, *L.* 114 0 0			
9 *per cent.* for *L.* 259 4 11 over-insured, 23 6 7¼			
Proportion of average, - - 7 3 4¼			
	144	10	0¼
Nett debit at Edinburgh, - -	56	5	10¼

				L.	s.	d.
Premium of 1150 at 26½ *per cent.* insured at London,				301	17	6
½ *per cent.* on 313 16 6 over-insured,				1	11	4½
				303	8	10½
Deduct 15 *per cent.* of *L.* 1150 for convoy,		*L.* 172	10 0			
11½ *per cent.* of *L.* 313 16 6 over-insured,		35	6 1			
Proportion of average-loss,		8	13 7½			
				216	9	8½
Nett debit at London,				86	19	2

Case 6. Average-loss on 474 hhds tobacco insured on the Peggy, from Virginia, on account of A. B. valued at *L.* 8 *per* hhd wet tobacco, 7 *per cent.* premium.

When the hhds were examined, and the contents proved, it was found, that 599 cwt. and 69 lb. or 67157 lb. were defaced, and that 22392 lb. were entirely lost, being distinguished and ascertained in a particular account made out for that effect. Hence for the loss it was stated:

	L.	s.	d.
If 1200 lb. wet tobacco give *L.* 8, insured *per* hhd. 22392 lb. must in the same proportion be charged with	149	5	7
67157 lb. cut or defaced, charged at ¼ *per* lb. for defacing,	69	19	1
	219	4	8
Deduct 2 *per cent.*	4	7	8
	214	17	0

For the average-loss *per cent.*
474 hhds.
at 8 *L.*

If *L.* 3792 is to be charged with *L.* 214, 17 *s.* loss, *L.* 100 must be charged with *L.* 5, 9 *s.*

OBSER-

OBSERVATIONS.

Of policies of inſurance, and deciſions concerning them.

What a policy of inſurance is, and the purpoſe for which inſurances are intended, hath been already taken notice of. The eſſentials that are to be expreſſed in a policy, or contract of inſurance, are in general:

1. The perſon's name for whom the inſurance is made, to which this unlimited declaration is commonly added, "for "his own, or any other perſon's account."

2. The goods, or ſhips, or their value, or, in ſhort, the thing itſelf upon which the inſurance is made.

3. The name of the place where the goods are ſhipped, whither bound, the time when the riſk commences, and when it terminates.

4. All the different kinds of dangers which the inſurer takes upon him.

5. The conſideration or premium received, or to be received, together with the name of the broker employed in the tranſaction.

6. How much ſhall be paid in caſe of loſs, and when due.

7. The day and year in which the contract or policy is executed.

8. The intelligence or advices relative to the adventure, at the time of making the contract or policy.

Who may inſure.

1. Any perſon, who, by the laws of his country, hath a right to diſpoſe of his property, may inſure; but in ſome places, where ordinances relating to inſurances are in force, there are exceptions, particularly concerning thoſe who are employed either in the management or direction of inſurances, as inſurance brokers, commiſſioners, and ſecretaries of any chambers or tribunals for judging of differences that may ariſe in this branch of buſineſs, ſince they ought all to be men ſtrictly impartial. In England and Sweden brokers alone are excluded from ſigning or underwriting policies. By all the ancient ordinances, and ſome modern ones, relating to inſurances, the inſured are particularly injoined to run part of the riſk themſelves, as the beſt means of avoiding frauds; yet we find that ſuch injunctions are commonly evaded, or, at leaſt, very ſeldom long complied with. The cuſtom of overlooking, or diſpenſing with the diſpoſition of the law in

thoſe

thoſe reſpects, have crept in every where; and when a judge, in caſes of diſpute, finds no viſible fraud committed, he cannot well act otherwiſe, than to oblige the merchants to adhere to, and fulfil their contracts, as the beſt way of promoting credit and trade in general.

2. *What may be inſured, and how.*

By modern laws and cuſtoms, inſurance may be made on divers kinds of merchandizes; on ſhips; on the freight or hire of ſhips; on the money for fitting out of ſhips; on bottomry, or money borrowed on the bottom of a ſhip; on ſhips and their cargoes jointly; on the profit expected by the goods; on intereſt and no intereſt, *i. e.* without further proof of intereſt than the policy; on the riſe or continuance of the current price of merchandiſes; on houſes, warehouſes, cellars, and the value of goods laid up therein, againſt danger from fire; on fiſheries; on the lives of men and cattle; on lotteries, *&c.*; the whole according to the circumſtances that may happen among the contracting parties.——The goods to be inſured ought to be declared in the policy as circumſtantially as poſſible, if the particulars are known by their marks, numbers, and package, rather than under the general expreſſion of merchandiſe; or if it be agreed to inſert thoſe particulars when known by the inſured, they ought by no means to be omitted; more particularly, if the inſurance be made for the account of ſeveral perſons, ſince by this ſpecification great trouble is prevented in proving to the inſurers the particular goods they inſured, which were more or leſs ſubject to damage. But on goods expected from abroad, it is more adviſeable to let the policy be made out under the general expreſſion of merchandiſe, than to inſert particulars, as orders for the purchaſe of foreign commodities cannot always be ſtrictly complied with by agents or factors, ſince many circumſtances may vary the orders given them for purchaſing of particular goods. Beſides, in the caſe of a dubious debt, goods taken in payment, different from thoſe that were ordered, may very prudently be ſubſtituted in their place. Every perſon making inſurance under the general expreſſion of merchandiſe, ought not to conceal any thing he may know which would require a greater premium than is commonly given. And for any damage happening to goods more liable to it than others inſured at a lower premium, the inſurer ought not to be anſwerable any farther than in common with the reſt of the cargo not ſo ſubject to damage.

According

According to the laws of ſeveral countries, ſuch things as in their nature are corruptible or periſhable, or contraband goods liable to confiſcation, are not to be underſtood under the general expreſſion of merchandiſe, ſince the inſured is obliged not to conceal any thing from the inſurer relating to the riſk he takes on him. It may nevertheleſs happen, that, through the unwarrantable proceedings of others, the ſhip may be expoſed to greater danger than the inſured may know; in which caſe the inſurer, not the inſured, is accountable for any loſs or damage.

Any perſon who hath laden different ſorts of goods, and intends to run part of the riſk himſelf, or to have them inſured at different places, hath it in his option, which of thoſe goods he will have inſerted in ſuch or ſuch a policy, and may chuſe from amongſt them ſuch ſorts or parcels for himſelf as are leaſt expoſed to average, unleſs he makes inſurance under the general title of merchandiſe. But then this choice ought to be made at the time of taking out the policies, and the marks and numbers of the merchandiſe be therein diſtinguiſhed; for if an inſurance hath at the beginning been made under the general expreſſion of goods, and ſome time after the inſured wants to have it expreſſed in the policy, as is frequently the caſe, that the riſk is run on ſuch and ſuch bales, the inſurer no doubt hath a right to inquire into the cauſe of this ſpecification, and particularly into the quality and condition of the goods; ſince, as long as they continued inſured under the general expreſſion of merchandiſe, and there happened to be on board others of a greater value, a joint obligation ſubſiſted among the inſurers, and none concerned therein ought to be prejudiced by ſeparating or dividing ſuch goods. An equal obligation may indeed more properly be ſaid to ſubſiſt amongſt ſuch of the underwriters as had inſured the value of ſuch goods as were brought abroad at one time, and who, previous thereto, had underwrote a policy; for it is certain, that if the ſhip wherein theſe goods were loaded as to-day ſhould be burnt at night, none would inſure them to-morrow. The riſk of the inſurers who firſt underwrote ought not therefore to be confounded with that which the inſurers of a later date muſt run, eſpecially at thoſe places where they anſwer for the riſks the goods run whilſt they are aboard the lighters in their paſſage to the ſhip, and only thoſe inſurers who ſigned the firſt policy ſhould jointly run the riſk of the goods in the firſt lighter, and ſo on, according to the rank and value. It is, notwithſtanding, ordinary in London to bring all the inſurers,

ſurers, who have ſigned at ſeparate times for the account of one and the ſame perſon, under the general expreſſion of merchandiſe, into one common riſk or average; but conſidering the remarkable difference there may be in the beginning and duration of the riſk, by goods being ſooner or later ſhipped and inſured, it will be obvious, that this cuſtom is not founded in equity. This diſtinction, however, will only be practicable in an outward voyage; for in a voyage inward it is impoſſible to be particular enough for aſcertaining the difference in point of time. The ſhares of ſhips ought alſo to be particularly denominated, and preciſely valued in the policy, eſpecially when it is not their firſt voyage; becauſe it will be difficult to prove what their worth may be in ſubſequent voyages, or what is really loſt of the original value by tear and wear.

For if the owner of one fourth of a veſſel, for inſtance, values it in the policy at *L.* 100, and only gets *L.* 400 inſured, it is clear, that he ought to be conſidered as an inſurer for *L.* 100 himſelf; and although, in a groſs average, the inſured's ſhare may be charged but at the rate of *L.* 400, he muſt nevertheleſs bear his proportion for *L.* 100 of that average, as a joint inſurer with the reſt.

3. *The damages to which the inſurers are liable.*

Theſe are deſcribed in all policies, and may be all or either of the following: the ſeas, men of war, fire, enemies, pirates, rovers, thieves, jettiſons, letters of mart and countermart, ſurpriſals, takings at ſea, arreſts, reſtraints, and detainments of all kings, princes, and people, of what nation, condition, or quality ſoever, barratry of the maſter and mariners, and of all other perils, loſſes, and misfortunes, that have, or ſhall come to the hurt, detriment, or damage of the ſaid goods, or any part thereof; and in caſe of any loſs or misfortune, it ſhall be lawful to the inſured, their factors, ſervants, or aſſignees, to ſue, labour, and travel for, in, and about the defence, ſafeguard, and recovery of ſaid goods, or any part thereof, *&c.*

However, a diſtinction is every where to be made between the damage that may happen to inſured goods on board a ſhip, and that which occurs by an actual ſhipwreck; for this laſt damage is, without doubt, to be made good by the inſurers, but the former may proceed from their bad ſtowage, or their being put in a place expoſed to wet, from a deficiency in caulking of the decks, or otherwiſe; which faults the ſhip

ought to be anſwerable for. But it is almoſt become an univerſal cuſtom for maſters, as ſoon as they arrive at any port, to go on ſhore and proteſt againſt any damage that in the voyage may have happened to their cargoes, by reciting any bad weather they met with: but this ſort of proteſts, it is to be preſumed, will not free the maſter from a further examination; eſpecially if the owners of the goods have any reaſon to believe that their damage proceeded from the ſhip, or the fault of the maſter, they may at all times bring him and his crew to declare upon oath, what they knew of the ſhip's condition, and in what place the damaged goods had been ſtowed.

The Eaſt-India company hire all the ſhips they employ in their trade from private people; and in the charter-party there is this general condition, that every ſhip ſhall make good all damages that may happen to the goods on board her; and further, that the company ſhall contribute nothing to any damage the ſhips may receive, by either cutting or carrying away maſts, loſing cables and anchors, or any other direful effects of tempeſtuous weather; ſo that what general cuſtom hath made a groſs average to be borne by ſhip and cargo, falls ſolely on the owners of thoſe veſſels which the company employ.

Of general or groſs averages.

Whatever the maſter of a ſhip in diſtreſs, with the advice of his officers and ſailors, deliberately reſolves to do, for the preſervation of the whole, in cutting away maſts or cables, or in throwing goods overboard to lighten his veſſel, which is what is meant by jettiſon, or jetſon, is in all places permitted to be brought into a general or groſs average; in which all concerned in ſhip, freight, and cargo are to bear a proportional part of what was ſo ſacrificed for the common good; and it muſt be made good by the inſurers in ſuch proportions as they have underwrote. To make this action legal, the three following particulars are eſſentially neceſſary.

1. That what was ſo condemned to deſtruction, was in conſequence of a deliberate and voluntary conſultation held between the maſter and men.

2. That the ſhip was in diſtreſs, and that ſuch ſacrifice was a procedure abſolutely neceſſary to ſave the reſt.

3. That the ſaving the ſhip and cargo was actually owing to the means uſed, with that ſole view.

If a deep-laden ſhip be obliged to take out a part of her cargo, previous to her paſſing ſome ſhoals or flats, which, without ſuch lightening, would hinder her getting to her deſtined port, and the lighters or boats in which the goods of ſuch cargo are put ſhould periſh, the owners of the goods ſo preſerved ſhall not only remain poſſeſſed of thoſe goods, but alſo ſhall contribute nothing towards the loſs of the ſhip and what was in her. This difference is founded on equity. The lightening of the ſhip was in conſequence of a deliberate and voluntary determination, and for the good of the whole; whereas the lighters being ſaved, and the ſhip loſt, was owing to an accident, nowiſe proceeding from a regard to the whole, but a caſe ſimiliar to the ſaving goods lying neareſt at hand when a ſhip is run aſhore. Suppoſe farther, that a ſhip running on a bank, throws overboard all her heavy ſtores, and part of her cargo, by which jettiſon ſhe gets clear, and returns to ſea, yet proves ſo leaky, that ſhe is obliged to make for, and take ſhelter in the next harbour, where, upon examination, ſhe is found in ſo bad a condition as not to be repaired, and therefore is condemned as unfit to proceed on the voyage; in this caſe, notwithſtanding her loſs proceeds from her having been aſhore, yet as ſhe got clear by the foreſaid jettiſon, and the remainder of the cargo eſcaped, and arrived ſafe in harbour, that which was ſo ſaved muſt contribute to the loſs of what was thrown overboard. But yet, whatever damage the ſhip ſuſtained by her running aground, or the damage or loſs any particular goods ſuffered by this unhappy accident, muſt be borne by the ſhip's owners, and by the owners of the goods, without any pretenſion of indemnification from the cargo ſaved, their redreſs being only againſt the inſurers. The ſea-laws of trading-countries differ greatly in fixing the prices at which goods thrown overboard ſhall be made good, and for what value thoſe ſaved are to contribute. By ſome of the moſt ancient ſtatutes in different countries, if the accident which occaſioned the general average happened before half the voyage was performed, the jettiſon is to be eſtimated at the price it coſt; but if after, then at the price which the reſt, or ſuch like goods ſhall be ſold for at the place of diſcharge, freight duties and ordinary charges deducted. The new ordinance of Amſterdam in 1744 ſeems to differ ſomething from this cuſtom, ſaying, that only in caſes of detenſions, and ranſoms, the contributions ſhall be made in theſe two different manners of valuation. Several ordinances, *viz.* of Antwerp 1563, Hamburg 1603, of France,

France, No 733. Lewis XIV. and of Conigſberg, No 8603 all agree, that the goods ſaved and loſt ſhall be rated at the market-price which thoſe ſaved ſell for, and a contribution be made accordingly, after deducting freight and charges. But by another ordinance of Hamburgh in 1731, it is ordained, that, in caſes of general average, the goods ſhall be eſtimated according to their invoice, with the addition of all charges excepting premium of inſurance. Hence ariſes the following queſtion, Which is the juſteſt way to reckon the goods, according to their value at the place they came from, or according to their value where they are landed? If the ſhip arrived in ſafety at the deſtined port, without doubt, both the goods thrown overboard, and thoſe ſaved, ought to be valued at the price they might have yielded, or did yield there, whether the jettiſon was made before they came half-way or after; for if the goods ſaved by this jettiſon arrived at the place where they were deſtined for, and there produced double what they coſt, it would be unreaſonable that one half of ſuch produce ſhould contribute nothing to what was caſt away; nor would it, on the contrary, be reaſonable to make the goods ſaved, if they come to a loſing market, pay for more than they produced: or ſuppoſe they were ſuch as ſuffered by their own periſhable nature, what reaſon could there be to make them contribute *ad valorem* of their coſt? As there is no law in England that poſitively directs what method is to be obſerved in theſe caſes, the inſurers as well as the inſured are bound by the determination of referees. Molloy, in his treatiſe *de jure maritimo*, remarks, that, in his time, the general cuſtom was, that the goods ſaved, and thoſe loſt, were eſtimated at the rate which the goods ſaved ſold for, freight and other neceſſary charges deducted; which indeed, from a compariſon of tranſactions in caſes of that kind, ſeems ſtill to be the prevailing cuſtom in England. Accidents may happen that may occaſion a contribution before the ſhip can reach her deſtined port. When a veſſel hath been obliged to make a jettiſon, or, by the damages ſuffered ſoon after ſailing, is obliged to return from whence ſhe came, the neceſſary charges of her repairs, and the replacing the goods thrown overboard, muſt be proportioned by a general average. In like manner, when ſhips in time of war are detained in foreign ports, and expoſed to greater expenſes in procuring their releaſe, there is no other way of ſettling a contribution for the payment of thoſe charges but on the firſt coſt of the cargo. With regard to ſome ſort of goods that arrive whither they

were bound after a jettiſon, it may be leſs inconvenient for all the concerned to ſettle, and make a reparation of the loſs upon the coſt of the whole cargo, than to calculate upon a forced ſale, or an inaccurate appraiſement. But no rule in this caſe can be made without exception, or which will not, in ſome occurrences, want amendment: for though a law may ordain, that each owner ſhall contribute proportionably to the coſt of his goods, yet if he can prove that they were ſpoiled, or had fallen conſiderably in value after ſhipping, it doth not ſeem equitable to compel him to any other contribution than *pro rata* of what his goods are worth at the time of ſettling the average. Hence the new ordinance of inſurance at Amſterdam, wherein there is the following clauſe: "Whereas accidents from whence general averages ariſe are "ſo variable in their circumſtances, that no ordinance can "well provide for them all, the deciſion of them ſhall be left "to the commiſſioners of the chamber of inſurances, to re-"gulate and determine according to law, reaſon, and e-"quity."——In a codex of commercial laws enacted at Bilboa, *anno* 1738, *c.* 21. treating in what manner groſs averages are to be regulated, it is ſaid, "That the major part of "the concerned ſhall have it in their choice to regulate the "value of the goods by the price appearing in the invoices, "or by what they ſhall be computed at by an appraiſement "made conformable to their current price at the deſigned "port, regard being had to the condition they come in, and "their quality; but that a repartition of no part of the aver-"age ſhall be made on the freight, without the unanimous "conſent of all the concerned and the captain."

Sailors wages, paſſengers cloaths, money, and jewels, and goods belonging to the king, are generally exempt from average-contributions; but in voyages from Cadiz and Liſbon, where the carriage of gold and ſilver makes a great part of the ſhip's profit or freight, if a perſon, under the cloak of going paſſenger, ſhould conceal either in his trunks, or about his body, any ſuch conſiderable ſum of money or jewels as would not be ſuffered without paying a freight, he muſt, when diſcovered, not only ſatisfy the freight, but alſo contribute to any jettiſon. It is cuſtomary in London, and moſt other countries, for the proprietors of whatever gold, ſilver, or jewels pay freight in merchant-ſhips to contribute to a jettiſon for their full value; and the worth of ſuch precious commodities being known, the care of them will be increaſed in proportion to their worth, to prevent their being thrown overboard

overboard promiſcuouſly with other things; and hence their preſervation redounds to the common benefit.

The ſeveral particulars that are admitted into general or groſs averages are as follow.

1. All damage that a ſhip ſuffers in her apparel and cargo, in defending her againſt an enemy, privateer, or pirate.

2. Extraordinary pilotage and charges which a ſhip ſhall be at in ſpringing a leak, or being obliged to take ſhelter in a harbour, by having received ſome other damage.

3. The neceſſary expenſes for aſſiſtance to get clear, when a ſhip is run aground, or the charges of lightening her on ſuch occaſions.

4. Whatever a maſter may have agreed to pay for the ranſom of his ſhip and cargo to any privateer or pirate when taken.

5. What may be expended in the care and extraordinary attendance on either officers or ſailors wounded in defence of the ſhip; and alſo what rewards may be promiſed by articles to the widows and children of thoſe who may unfortunately loſe their lives in the engagement.

6. The extraordinary gratuity which a maſter may have promiſed to his men, to animate them to a ſtout defence or ſalvage of the veſſel.

7. All maſts, cables, and rigging, either ſlipt, cut, or carried away; and all ſails or other appurtenances torn or ſpoiled in order to ſave the ſhip.

8. All that is thrown overboard, or damaged by a jettiſon, for the ſhip's ſafety.

9. The value of any goods or ſtores taken away or plundered by privateers, or other commiſſioned ſhips, with a promiſe to pay for them.

10. Charges occaſioned by an extraordinary quarantine, and other unavoidable accidents.

11. Whatever holes are cut in a ſhip, in order to have the water run out, or conveyed to the pumps, when by ſhipping a ſea ſhe is filled.

12. The ſhip's boat, if cut away from its faſtenings, and ſet adrift.

13. The expence of getting a ſhip afloat after running aſhore, and that of repairing the damaged works under water.

14. Goods loſt by being put into any other veſſel or lighter, and there periſhed, when otherwiſe they muſt have been thrown overboard.

15. The

15. The charges which a maſter pays for bringing his ſhip to a place of ſafety on being chaſed by an enemy; or if ſhe lay in a dangerous part, waiting for a fair wind, or convoy.

16. The charges of lawyers, attorneys, and procurators, for reclaiming ſhip and cargo. Travelling expenſes of perſons concerned in the ſolicitation; gratuities given on ſuch occaſions; proteſts; tavern expenſes at meetings about it; poſtages, commiſſions to merchants or factors who have the direction and care of it; brokerage.

17. Charges for the hire of anchors and cables, *&c.*

18. Lighterage for the unloading and demurrage.

19. Horſe, cart, and waggon hire when goods are carried over land.

20. Gratuities to lords of manors, and proprietors of lands, for leave to dig a ſhip off that is drove athore above high-water mark, either by a ſtorm or tide, and the charges in performing it.

21. Coſt of repairs to carpenters, blockmakers, ſmiths, ſailmakers, *&c.*

22. Charges of laying in freſh ballaſt; rewards promiſed, to the ſailors more than their wages for extraordinary labour in the ſhip's preſervation.

23. Intereſt, premium of inſurance, and commiſſion on monies diſburſed.

24. Charges of victualling and guarding the ſhip during her detention, with coſt of inſpecting cuſtom-houſe regiſters, to find out who may be concerned or proprietors.

Theſe particulars are collected from the ordinances of ſeveral countries, and Mr. Langenbeck's annotations.

The ſum on which a general average ought to be computed, is fixed by examining what the whole ſhip, freight, and cargo, if no jettiſon had been made, would have produced nett, if they had all belonged to one perſon, and been ſold for ready money; and this is the ſum whereon the repartition ought to be made, all the particular goods bearing their nett proportion, neither more or leſs.

5. *Of particular averages.*

Ever ſince the year 1749 it hath been the cuſtom in England for the inſurers to pay no particular average under 3 *per cent.* and in moſt places of Scotland where there are inſurance-offices under 5 *per cent.* In Hamburg general averages are not paid if they do not amount to 3 *per cent.* but in London

don general averages are always ſatisfied, be they ever ſo ſmall. There is certainly a deficiency in almoſt all ordinances relative to particular averages, in not fully explaining when, and after what manner the damaged ſhall be deemed to exceed 3 *per cent.* For inſtance, if in a cheſt containing 100 pieces of linen, three pieces are deducted for damage, and as ſuch allowed to the buyer, the loſs ought to be recoverable from the inſurers whether that cheſt was in a policy by itſelf, or amongſt a parcel of an hundred cheſts; for why ſhould not a perſon who hath inſured and paid an equal premium for 100 cheſts, have the ſame advantage as he that is inſured but for one? Suppoſe a merchant has ſhipped 101 bales of goods from No 1. to 101. of which, on arrival, three bales are by ſea, or ſome other accident, ſo ſpoiled as to be worth nothing; if the damage be calculated as on the whole value of 101 bales, it will not amount to 3 *per cent.* and is by moſt inſurers thought not to be recoverable by the inſured, eſpecially if the inſurance be made, without expreſsly declaring in the policy the particular ſum inſured on each bale. It is more than probable, however, were ſuch a caſe rightly explained to a jury of merchants, the inſurers would be condemned to pay the value of theſe three bales, in the ſame manner as they would if it had been expreſſed how much was inſured on each bale, or as if the 101 bales had been inſured in five different or diſtinct policies; in which caſe, ſuppoſing a bale totally loſt in each of three of the parcels, the underwriters would certainly have been liable for the loſs, as it would have been more than 5 *per cent.* The law or cuſtom by which underwriters are not chargeable with any particular loſs below 3 *per cent.* was no doubt made to free the inſurers from the vexation of being called upon to make up every frivolous damage that might happen in a few pieces of a cheſt or bale; but it certainly would be wrong, notwithſtanding an inſurance ſhould be made under the general expreſſion of goods or merchandiſe, to conſider each different parcel or kind of goods as a part of the whole, when it may amount to a conſiderable value: it ought certainly to be conſidered by itſelf; and if the damage in that cheſt or parcel amount to 3 *per cent.* of the value of the cheſt or parcel the inſurers ſhould be accountable. However, as this may admit of diſpute for want of eſtabliſhed rules, it is beſt for the inſured to put the matter paſt queſtion, by explications in the policy.

6. *Of*

6. *Of barratry.*

In London and Antwerp, according to Stracia, and as it is expreſſed in an Ancona policy of the year 1567, the inſurers were even ſo early as then obliged to anſwer for the barratry of the maſter; and a policy of Florence, of the year 1523, alſo comprehends the riſk *di barrateria di padrone e di contrebanda, di Veneziani, ſalvo de ſtiva e dogana.* The new Stockholm ordinance of 1750, declares, "That the inſurers "alſo ſhall be anſwerable for all the damages that may happen "to the ſhip and goods through negligence or knavery of "the ſhip and crew, of whatever kind they may be, and that "they may ſeek their redreſs againſt the maſter." But this ordinance makes a diſtinction: for in caſe any goods ſhould be miſſing or loſt, for which a bill of loading hath been ſigned, the inſured ſhall firſt have recourſe againſt the maſter's perſon and eſtate, and for what falls ſhort in theſe, againſt the ſhip and freight; but if all is not ſufficient, he then has a right to ſue the inſurers for the deficiency. The moſt ancient record that is found in England concerning this matter is that in Edward III's time, where one brought an action of treſpaſs againſt the maſter for an embezzlement by his mariners of twenty two pieces of gold, a bow, a ſheaf of arrows, a ſword, and ſome other things, and adjudged he ſhould anſwer. This record was certified into chancery, in order to have it ſent into the King's bench, to enable the plaintiff to bring an action upon the ſame judgement in any place of England where he could meet with the defendant; part of which runs thus: *Et prædictus Jurdanus venit et dicit, quod lex de Oleron talis eſt, quod ſi aliqua bona et catalla migiſtro alicujus navis liberata ſunt cuſtodienda, unde idem magiſter, pro eiſdem vel pro aliqua alia re, in eadem navi facta manu capit, illo modo magiſter navis tenetur reſpondere, non alio modo; et ſuper hac petit judicium. Et prædictus Hen. dicit, quod unuſquiſque magiſter tenetur reſpondere de quacunque tranſgreſſione per ſervientes ſuos in navi ſua facta; et petit judicium ſimiliter*—— The whole of this is recorded in Molloy *de jure maritimo, l.* 1. *c.* 3. § 16.

Where a ſhip was inſured againſt the barratry of the maſter, *&c.* in an action brought thereupon, the jury found, that the ſhip was loſt by the fraud and negligence of the maſter; the court held, that if the maſter run away with the ſhip, or embezzle the goods, the merchant may have an action againſt him; for it is reaſonable that merchants who ha-

ward their ſtocks in foreign trade, ſhould ſecure themſelves in what manner they think proper againſt barratry of the maſter and all other frauds; and this muſt be intended fraud in the maſter, not a bare neglect: and they all agreed that fraud is barratry, though not named in the covenant, but negligence ought not. 1 *Mod. c.* 230. 231.

Cambridge brought a writ of errour upon a judgement given againſt him in the common pleas, in an action brought by the plaintiff upon a policy of inſurance of the ſhip Riga Merchant at and from Portmahon to London; and Serjeant Braithwayte for the plaintiff in errour inſiſted, that the judgement was erroneous, becauſe the breach was ill aſſigned; becauſe the policy was, that the defendant Cambridge ſhould inſure the ſaid ſhip, among other things, againſt the barratry of the maſter, and all other dangers, damages, and misfortunes which ſhould happen to the prejudice and damage of the ſaid ſhip; and the breach aſſigned was, that the ſhip, in the ſaid voyage, *per fraudem et negligentiam magiſtri navis prædictæ depreſſa et ſubmerſa fuit, et totaliter perdita et amiſſa, et nullius valoris devenit.* This he inſiſted was not within the meaning of the word *barratry*, but the breach ſhould have been expreſs, that the ſhip was loſt by the barratry of the maſter. Beſides, the owner of the goods hath a remedy againſt the owners of the ſhip for any prejudice he receives by the fraud or neglect of the maſter; and therefore there is the leſs reaſon the inſurer ſhould be liable. Beſides, if the word *barratry* ſhould import *fraud*, yet it does not import *neglect*; and the fact here alledged is, that the ſhip was loſt by the *fraud* and *neglect* of the maſter. But the court was unanimouſly of opinion, that there was no occaſion to aver the fact in the very words of the policy; but if the fact alledged came within the meaning of the words in the policy, it is ſufficient. Now, barratry imports fraud, (*du Freſne gloſſ. verbo barratara, fraus, dolus*), and he that commits a fraud may properly be ſaid to be guilty of a neglect, *viz.* of his duty. Barratry of a maſter is not to be confined to the maſter's running away with a ſhip, and the general words of the policy ought to be conſtrued to extend to loſſes of the like nature, as thoſe mentioned before. Now, loſſes ariſing from fraud of the maſter are of the ſame nature as if he had run away with the ſhip, ſuppoſing barratry was to be confined to that which it is not, becauſe it imports any fraud. The judgement was affirmed, April 27, 1724. *Stran.* 581.

7. *How the damage is to be borne when two ſhips run foul of one another.*

Moſt modern marine laws ordain, that when two ſhips nowiſe wilfully but accidentally run foul of each other, they ſhall equally bear the loſs or damage which enſues. But if the moiety of the damage done to one of them ſhould exceed the value of what the other can make good, no claim ſhall extend farther than the produce of the whole; ſo that the owners, by giving up what was theirs, are freed from any further demands. The cuſtom of dividing the damage equally, which happens by ſuch accidents on each ſhip, was not heretofore general: for in ſome parts an eſtimation of both ſhips and cargoes was made, and each bore the damage in proportion to their value. In the 68th article of the laws of Wiſby it is thus expreſſed: "If it happens that by ſhips running "foul of each other, one of them with their cargo be loſt "the goods in both ſhips ſhall be appraiſed, and what is "loſt be rated at ſo much in the pound, on the value of what "each had in, and the ſame poundage ſhall be calculated on "the value of the ſhips"

Molloy, *de jure maritimo, l. 2. c. 6. §* 10. ſays, "If two "ſhips happen to encounter, and croſs each other, and the "crew ſwear their innocence, contribution muſt be made by "a juſt equality; but if one periſh, as there can be no me"dium for proportioning the loſs, ſo there would be no con"tribution."

8. *Of premiums.*

The premium which an uſurer receives, binds him to anſwer for all ſuch damages and loſſes as are expreſſed in the policy; and if the inſured pay more than a common premium, it muſt certainly imply a reaſon why more than the current premium at the time was given, and an inſurer by accepting it, tacitly admits it to be a ſufficient conſideration for any circumſtance whatever; ſo that this extraordinary premium being proved, allegations of concealments, or uncertain rumours of retardments, will be of no great weight againſt the inſured.

The payment or non-payment of a premium before a loſs happens, makes no alteration in an inſurance, according to the preſent cuſtom, as the inſurers may inſiſt upon their being ſatisfied at the time of their underwriting, if they do not incline to give credit for it. At London, Edinburgh, and Glaſgow,

Glaſgow, when inſurers ſign to brokers, and office-keepers, it is they only who are to be looked on as debtors for the premium.

When an inſurer hath an open account directly with the inſured for the premium, in caſe of the inſured's failure, it is preſumable, that he hath a prior right againſt the goods he inſured, when arrived, if remaining on board. A caſe which was decided at Hamburgh, where a bill of lading of goods for account of a perſon in France, was pawned by the factor to whom they were conſigned, together with a policy of inſurance he had made on them, ſeems pretty much calculated to confirm this opinion. The queſtion in this caſe was, which ſhould firſt be ſatisfied, the premium, the loan, or the proprietor? As it happened that the proprietor had not inſured the goods in France, the inſurance done at Hamburgh in caſe of a loſs, muſt have been recovered, either for his benefit or that of the lender; it therefore was but reaſonable that the inſurer ſhould be paid his premium prior to both. Hence premiums of inſurance are a kind of hypothec of the goods inſured, and bills of lading and policies of inſurance are but bad ſecurities to lend money on; becauſe, if the aforementioned goods had been inſured elſewhere by the ſhipper, or right owner of them, the inſurance made by him who pledged them would not have been paid in caſe of a loſs.

In caſe the inſurer fails while the inſured's property is at riſk, by the ordinances of moſt countries, the inſured is at liberty to make inſurance *de novo*, and to draw back his premium, at leaſt to become a creditor for the premium if it hath been paid, and accordingly ſhare *pro rata* of whatever the bankrupt's eſtate produces; but if a total or partial loſs hath happened, and been made public previous to the inſurer's failure, the inſured can only claim to be admitted as a creditor on the inſurer's eſtate. Amſt. No 536, Hamb. No 965. Stockh. No 1098.

9. *The documents requiſite to recover a loſs.*

It is not eaſy to enumerate the different proofs or documents requiſite to aſcertain and recover a loſs.——We ſhall condeſcend on a few.

It is common for inſurers to aſk,

1. What is inſured elſewhere upon the ſhip or goods for which the loſs or damage is demanded?

2. It is ordinary to ask for the proteſt, which is a declaration upon oath uſually made by the maſter and ſome of his people, before a juſtice notary-public, or conſul at any place where they firſt arrive, ſetting forth whatever bad weather they met with on the voyage, or any other accident that befel them; as alſo what precautions they took to guard againſt the ill conſequences to be apprehended from thoſe accidents, with the motives they had for going into any other harbour than that they were bound to; which ſort of proteſts are now become almoſt a mere matter of form, as a notion is propagated at ſome places, that if the maſters neglect proteſting immediately after their arrival, againſt the damages that have reſulted from any bad weather, they make themſelves anſwerable for thoſe damages that ſhall be found in any of the goods aboard, from which they believe a proteſt frees them. But this cannot be ſufficient to clear them on all occaſions. It is true, the French ordinance of 1681, *tit.* 10. *de conges et rapports, art.* 4. injoins, "that all maſters ſhall be obliged to "make a report within twenty four hours after their arrival "before the lieutenant or judge of the admiralty, of all that "hath happened in their voyage." But it is to be preſumed that the intent of this order is only to prevent the making any partial declarations, by not allowing time and room for it; which might have ſome weight where the maſter was no way concerned, and not when the queſtion is, whether the damage did not proceed from his own careleſſneſs bad ſtowage, or defect in caulking of his decks; for, on any appearance of ſuch neglects, the proprietors of the goods have a right, notwithſtanding the proteſt, to inſiſt that the ſhip be viſited and a particular examination of the crew taken, how and where theſe goods were laid. At Hamburg it is the cuſtom ſoon after the ſhip's arrival, though not juſt within twenty four hours, to ſend a printed notification to every perſon who hath goods on board, importing that the maſter fears his cargo may have received damage; the intent of this is, that all who have goods to receive, may ſend to inſpect the ſhip and the places where they were ſtowed, before they take them aſhore. This is certainly a very prudent precaution, and greatly tending to the maſter's juſtification. At London maſters ſeldom do any thing more than to have their intentions of making a proteſt noted before a notary-public, without giving any information to the perſons who are to receive the goods, *&c.*

3. For the bills of ſale, and often for the coſtomhouſe-regiſters,

regiſters, to find out the owners when inſurance is made on the body of a ſhip.

4. For bills of lading ſigned by the maſter, which are uſually called for to prove an intereſt in goods; but if there is any apparent reaſon to diſtruſt their being genuine, all ſuch clearances or regiſters from the cuſtomhouſes as are ordinarily given where the ſhip hath been diſpatched, are called for; and upon proofs of ſuch authority a greater dependence in general may be made than upon mere bills of lading; more eſpecially upon certificates from thoſe regiſters which the Spaniſh ſhips, in their Weſt India trade, carry along with them, and of which duplicates remain behind in the cuſtomhouſe. For the manner of making ſuch a regiſter is, that every perſon who hath goods to ſhip, previous to their embarkation, gives an account of their bales and marks, and pays a duty for them, either by weight or meaſure, which is explained in a cocket; and when they paſs the gates, or go to be ſhipped, they are ſearched to ſee whether they correſpond with the entry delivered in, and if they do, each parcel is marked with a cuſtomhouſe-ſtamp, and the cocket ſigned by the ſearchers: when on board, another ſet of viſitors re-examine them, and put their *examplido* upon each cocket, out of all which the general regiſter is framed, to go by the ſhip, in order to a re-examination by the King's officers at the places of unloading in America.

By an ordinance of Hamburg, *anno* 1603, it is ſaid, that every maſter is diligently to inſpect the ſtowage of the goods and to take care they be not expoſed to damage; for if any enſue, or they be diminiſhed through the maſter's fault, or that of the mariners, the former ſhall be obliged to make ſatisfaction to the merchant for the ſame. And it is remarked in Languebeck's annotations upon this law, that although the city of Bourdeaux, as well as ſeveral others both in France and Italy, where wines are ſhipped, keep a ſet of ſworn labourers, or ſtowers, to ſtow goods well aboard of ſhips, the maſter is not thereby freed from ſuperviſing, or being anſwerable for the ſtowage, as ſome of them have pretended, becauſe the ſtowers muſt put them in ſuch places as the maſter or his officers direct. And the inſufficiency of ſuch a plea was proved in a law-ſuit carried on there before the admiralty in Hamburg in 1725, by Teſſier againſt Capt. Detloft.

In moſt policies the time is expreſſed when inſurers ſhall pay in caſe of a loſs. At Hamburg, where elſe no abandon of effects is admitted, the ordinance ſays, No. 939. "that "when

"when a ſhip bound to a place in Europe ſhall not be heard "of in three months beyond the uſual time for ſuch a voy- "age, ſhe may be conſidered as loſt, and the inſured is per- "mitted to abandon ſhip and cargo to the inſurers, and to "demand payment of the ſums they have reſpectively under- "wrote. The inſurers ſhall be obliged to pay 92 *per cent.* "within two months from and after the time ſuch abandon "was notified to them, on behalf of the inſured, by the bro- "ker, or their diſpatcher." And in No. 940. "That in caſe "the inſurers ſhould make any demur to pay within the be- "fore limited time, the inſured may ſtay until fourteen "months are elapſed from the time of the ſhip's departure "and then the inſurers ſhall be obliged to pay 100 *per cent.* "without any deduction: and if the inſured deſires in the "mean while to have ſecurity given, they ſhall be obliged to "give it." But whenever there is certain advice that a ſhip is loſt or taken, and her ſalvage and recovery deſperate, the ſame ordinance directs, No 961. "That the inſurers ſhall "be obliged to pay at the rate of 98 *per cent.* within two "months from and after the time that ſuch loſs hath by the "broker been notified to them, provided that ſuch loſs hath "before been proved by the proper and neceſſary docu- "ments."

It is appointed by the ordinance of Amſterdam, N° 573, that a loſs is to be paid within three months after its being notified; by that of Copenhagen, N° 1259. within two months after proof; by the *recapilacion des leyes de Indias* in Spain, N° 105. within ſix months after its being duly proved, and within eighteen months after the ſhip has ſailed, if no advice is received. At London it is cuſtomary with the inſurance-companies, in a week after the adjuſtment of the loſs, to pay 98 *per cent.* deducting a half *per cent.* for prompt payment; the private inſurers pay the ſame ſum of 98 *per cent.* in a month after the loſs is ſettled, and both the one and the others, in caſes of ſalvage and reclaims, are always very ready to advance ſomething to account, for carrying on ſuits, either upon the reaſonableneſs of the thing, or a tender of proper ſecurity. At Glaſgow and Edinburgh, upon ſettling the loſs, the underwriters grant bills at three months, which the inſured can ſell for ready money, allowing diſcount for the time to run.

10. *Of return of premium in caſe of convoy or over-inſurance.* It is ordinary, when the inſured expects convoy, to agree for

for a certain premium without convoy, ſo much thereof to be returned in caſe of convoy; and it is likewiſe an univerſal cuſtom, that in caſe too much is inſured, or inſurances made at divers places without fraud, the firſt ſhall ſtand good, and the laſt inſurers ſhall return the premium, keeping only ½ *per cent.* for their trouble of keeping a book or account of it. It often happens that goods are inſured to come in certain ſhips expected from abroad, which do not come by them; and as in this caſe no riſk is run, the inſurers are obliged to return the premium as above. Sometimes ſhips that have begun to load change their voyage, and unload again what they have aboard; under which circumſtances the inſurers are entitled to ſomething more than half *per cent.* for the time the riſk continued, though, whilſt the ſhip was in port, it could be but very ſmall. The ordinance of Amſterdam, N° 534. allows in ſuch caſes to keep 1 *per cent.* And the Stockholm ordinance, N° 1072. directs, that it ſhall be ſo much as impartial arbitrators, or their judicial court of inſurances, ſhall adjudge. At London it is commonly inſiſted, that all who have inſured on goods expected for one and the ſame perſon's account, without particulariſing them, whether they be comprehended in one or more policies, and underwrote ſooner or later, ſhall contribute equally to any loſs, or the return of premium, if over-inſured; which would be right had all the ſeveral policies been ſigned before any goods went on board, but not otherwiſe. For, ſuppoſe a perſon who expected goods from Jamaica in the ſhip Sailſure to the value of *L.* 5000, inſures *L.* 2000 proviſionally at the London inſurance office, under the general expreſſion of merchandiſe, before he knew of any goods being ſhipped, on his receiving advice ſome time after that the value of *L.* 2000 was gone on board, he got *L.* 3000 more inſured by the royal inſurance company. Now, it would ſeem plain, that *L.* 2000 value of the goods firſt ſhipped ought to be applied to the London inſurance-company, and not mixed with the goods loaded laſt. For it is poſſible that the Sailſure might have periſhed in the harbour by ſome accident, with only the firſt ſhipped goods on board, and before the reſolution was taken in London to increaſe the inſuranee, conſequently the royal exchange company would not have been comprehended in the ſaid loſs. The ordinances of moſt countries with reſpect to this particular leave room for law-ſuits, as not being ſufficiently explicit. The laws of France, Holland, Hamburg, and Stockholm ordain, that only the perſons who underwrote

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one and the ſame policy ſhall ſtand upon an equal footing, and that the firſt ſigned policy ſhall firſt ſtand good, which likewiſe would admit, upon an appeal to equity, of ſome diſtinction.

When an inſurance is intended to be done abroad, and at home, an explanation in the policies on both ſides, which ſhall have the preference, or ſtand good firſt, is a very material circumſtances, becauſe this cannot be decided by the dates alone. For inſtance, a perſon reſiding in Hamburgh had the value of 20,000 rix-dollars, or *L.* 2400 *Sterling*, to ſhip for Liſbon, and had actually loaded on the firſt of July to the valtie of 4000 rix-dollars, and thereupon gave an order of that date to his correſpondent in London, to get inſurance done for *L.* 1000 *Sterling*, without any limitation either in premium or circumſtances; and on the 4th July he got inſured at Hamburg the remaining *L.* 1400, or 5833⅓ rix-dollars, although he had not then ſhipped more than the firſt mentioned 4000 rix-dollars; but the 5th of July ſome circumſtances occurred that induced him to alter his deſign, and to reſolve on ſhipping no more: now, the query is, who ought to make a return of premium, according to the ſenſe of the Hamburg ordinance? To determine this, it ought to be conſidered, that, notwithſtanding the underwriting of the London inſurers muſt be of a later date than that of the Hamburgh inſurers, who underwrote the 5th of July, becauſe the order ſent to London on the 1ſt of July could not poſſibly arrive there before the 7th, and therefore the underwriting in London could not be before that or the next day; yet it ſeems evident, that the inſurance in London, though later in date, ought to ſtand good before that made at Hamburg: for if between the firſt of July, that the order for inſurance was ſent to London, and the 4th of the ſame month when it was made at Hamburg, the ſhip had been burnt, this laſt-mentioned inſurance could not have taken place, and conſequently that done in London, on the order given on the 1ſt of July, muſt have borne the entire loſs of theſe firſt-ſhipped goods; therefore the return of premium ought to be made by the Hamburgh inſurers, notwithſtanding it is ſaid in the ordinance of that city, No 919. "That the policy which is firſt "in date ſhall firſt ſtand good."

11. *Of re-inſurances.*

Re-inſurances may be as juſtifiable, and made with as little ſcruple as inſurances, provided the true motives for doing

them are not concealed. By an act of parliament paſſed in England 25th March 1747, No 1297, it is enacted, "That "it ſhall not be lawful to make re-inſurance, unleſs the in- "ſurer ſhall be inſolvent, become a bankrupt, or die; in "either of which caſes, ſuch inſurer, his executors, admini- "ſtrators, or aſſignees, may re-inſure to the amount of the "ſum before inſured, provided it ſhall be expreſſed in the "policy to be a re-inſurance." The liberty given in this act, for the executors of an inſurer who dies ſolvent and in good circumſtances, to re-inſure, is very neceſſary, and will often be done by his heirs to ſecure the eſtate he hath left. But to make re-inſurances for inſolvent inſurers, or for thoſe who become bankrupts, will ſeldom happen. The inſured will naturally take care of themſelves, by making freſh inſurances as ſoon as poſſible, and not neglect to put the loſs of the principal out of the queſtion, when they can do it by only paying a new premium. It is highly expedient for the inſured, in this caſe, not to wait on what is never likely to be done, but to do the beſt for himſelf by making a new inſurance; and ſuppoſing the bankrupt's adminiſtrators were to re-inſure, if a loſs happened, as the premium of this re-inſurance muſt come out of the common ſtock, it would ſeem that the recovery of ſuch loſs ought to come to the common benefit.

12. *Of inſurance on lives.*

Mens lives with good reaſon are and may be inſured, to ſecure to a creditor the reimburſement of a ſum advanced to his debtor for purchaſing a poſt or place, out of the income of which he may have a ſufficiency, beſides his maintenance, and expenſes, intereſt, and premium, to pay off yearly a part of the capital: however the lender ought not to inſure the life of the borrower without having his conſent. In ſome places inſurances are not permitted on the lives of perſons at the head of government; as at Genoa, No 155. no inſurances may be made, *ſine licentia ſenatus, ſuper vita pontificis, neque ſuper vita imperatoris, neque ſuper vita regum, neque cardinalium, neque ducum, principum, epiſcoporum, neque aliorum dominorum, aut perſonarum eccleſiaſticarum, ſeu ſecularium in dignitate conſtitutarum.* In London however people may make inſurance on any one's life without exception; and the inſurers ſeldom inquire much, if there are good or bad reaſons for ſuch an inſurance but only what the perſon's age is, and whether he be of a good conſtitution. The common premium on a good life, from twenty to fifty years of age, is 5 *per cent.* and from fifty to fix-

ty years of age, 6 *per cent. per annum*. But theſe premiums are higher than any computations founded on obſervations concerning the probability of human life will warrant.—People ought by all means to be prevented from getting inſurances done with ſiniſter views, eſpecially that inhuman one of committing murder, to gain the ſum inſured; an inſtance of which villany happened a few years ago in a London apothecary, who having got his wife's life inſured, ſoon after killed her. Underwriters ought therefore to inform themſelves of the motives why an inſurance is required, and not to be contented with obſcure, plauſible, or fictitious reaſons. It is indeed true, that the inſurers are not obliged to pay to a murderer convict, as happened in the caſe of this apothecary; yet this does not reſtore the life ſacrificed. A great part of the inſurance done on lives in London are for people who have certain expectations in reverſion, after the death of ſome friend or relation, whoſe poſſeſſions they have a mind in ſome meaſure to anticipiate by theſe means. But ſuch inſurances ſeem not eaſily to be juſtified, as they fruſtrate the intention of the bequeather, and frequently overſet a good deſign: and a fine eſtate may be ſoon anticipated by this irregular method.

All ordinances of inſurances allow it to be made upon the lives of captives in ſlavery; but to ſubſiſt no longer than the bondage does, or till the perſon be redeemed. An office for the inſurance of lives at Serjeants-Inn was erected the 25th July 1706, by a charter from Queen Anne granted to the then Lord Biſhop of Oxford, Sir Thomas Allen, and others, for incorporating them and their ſucceſſors, by the name of the "amicable ſociety for a perpetual inſurance-office," whereby they might provide for their wives, children, and other relations, *&c.*; and the chief view of the Biſhop of Oxford ſeems to have been, to induce clergymen to ſave a premium out of their yearly income, for inſuring their lives, ſo that when they died, their families might recover the ſums inſured, which hath been a comfort to many perſons.—This ſeems to be a good inſtitution, and carries in it a view, not the leaſt beneficial for thoſe for which inſurances on lives were originally deſigned. The lives of cattle may likewiſe be inſured, provided the inſurance is made before any reigning diſtemper hath got amongſt them; in this caſe the value of the cattle ought to be aſcertained in the policy as well as the period when the riſk begins and ends.

13. *Inſurance*

13. *Insurance on lotteries.*

It hath sometimes been practised, when a lottery was on foot, to insure for a certain premium, that a ticket should not be drawn a blank; and if it was, that the insurer should pay for that ticket a certain sum agreed on. In order to have a clear idea of the design of insuring tickets, it will be proper to take notice, that not above one half of the tickets in any lottery are fairly sold out to the public before the drawing; that is, so as not to come to market again: for a great many people buy a quantity of tickets, without any intention of venturing a single shilling in the lottery. These buy at a low price, and when they find an opportunity of selling to advantage, they bring them to market again; and if this opportunity does not offer before the drawing begins, they generally insure them; for which purpose there are a set of underwriters who open offices in Jonathan's, and paste up their names over their several stalls nearly in this manner: "Tickets insured from "blanks by A. B. and company:" their principal business is to insure tickets from blanks, or, in other words, to give an undrawn ticket for every one that is drawn a blank, during the time they are insured. This branch of insuring is calculated to serve those who go into the wheel with a number of tickets, designing to sell them at a high price, if they grow scarce, or the great prizes happen to stay long in the wheel; but whether the insuring tickets in this case, or the risking the chance of the wheel, and buying fresh tickets, in the room of those drawn blanks, with the money that is saved by not insuring, be most eligible, is a matter of doubt.

The price of insurance from blanks runs generally betwixt 5 *s.* and 5 *l.* as the drawing advances; and it sets off at first lower or higher, in proportion to the number of blanks there are to a prize in the scheme of the lottery, and as the risk is lesser or greater. This insurance is for real property; but there is a gaming kind of insurance not less considerable than the former, and full as profitable.——As the gentlemen insurers, previous to the opening their books, have held a committee, in which the nicest calculations have been made, and the price fixed, with the moderate allowance to themselves of 25 *per cent.* profit upon the whole: it is a matter of indifference to them, whether the persons who bring a list of numbers to insure are really possessed of those tickets or not, provided they comply with the conditions required of those who are really possessed of tickets; *viz.* to deliver up the blanks when drawn

in exchange for undrawn tickets. I am therefore at liberty to carry any indifferent number, or the number of my ticket, (if I have one); the only difference is this, that in the one caſe I give up the blank for an undrawn ticket, and in the other I allow the value of the blank, and take either an undrawn ticket, or if I am no adventurer in the lottery, the value of an undrawn in money. Another method of gaming is to inſure for prizes; that is, to give in any liſt of numbers whatever, and if any of them are drawn prizes during the time they are inſured, I receive for every prize ſo drawn the value of *L.* 20 prize in money. The price of inſuring in this manner is generally from 1 *s.* 6 *d.* the firſt day to 5 *s.* towards the end of the drawing.

14. *Inſurance from fire.*

Inſurances from fire are introduced almoſt into every country under one denomination or other. At London inſurances of this kind are obtainable at ſuch eaſy rates, that there are few merchants but chuſe to be inſured for their own quiet. Beſides, this premium adds to their credit both at home and abroad, when it is known that the great capitals lying in their houſes and warehouſes are thus ſecured from the flames. Here the premium on brick houſes, or goods lodged in them, is but 2 *s* on each 100 *l.* to the value of 1000 *l.* and 2 *s.* 6 *d.* to the value of 2000 *l.* excepting where hazardous trades are carried on, ſuch as ſugar-refiners, diſtillers, and chandlers or, on dangerous commodities, ſuch as hemp, flax, *&c.* as will appear by the propoſals and policy of the London inſurance-company, No 1332, which hath taken a very good and neceſſary precaution, by inſerting the condition, that whenever any houſes are burnt, it ſhall be optional to the ſaid company either to pay the loſs or rebuild them. For this takes away the temptation from all inſured leaſeholders of deſtroying their houſes, as the landlords, and not they, in ſuch caſe, would be benefited by it. And it is a ſimilar good diſpoſition, that when goods are burnt, the inſurers ſhall have it in their choice either to make a pecuniary ſatisfaction, or to repair the damage by a quantity of merchandiſe, equal in kind, value, and goodneſs to thoſe damnified or loſt, which effectually prevents any iniquitous people, who may have a parcel of goods on hand greatly fallen in price, from ſetting them on fire, in expectation of recovering from the inſurers what they coſt.

Deciſions

Deciſions relative to the foregoing obſervations.

1. *A* having got a doubtful account of his ſhip at ſea, *viz.* that a ſhip deſcribed like his was taken, inſured her without giving any information to the underwriters of what he had heard, either as to the hazard or circumſtances which might induce him to believe his ſhip was in danger, if not actually loſt.——The inſurers brought a bill in chancery for an injunction, and to be relieved of this inſurance as fraudulent; which being found juſtly alleged, the Lord Chancellor pronounced the following decree: "The inſured hath not dealt "fairly with the inſurers, in this caſe; he ought to have diſ-"cloſed to them what intelligence he had of the ſhip's being "in danger, in which caſe it is impoſſible to think that the "inſurers would have underwrote the ſhip at ſo ſmall a pre-"mium as they had done, but would either not have inſured "at all, or would have inſiſted on a larger premium, ſo that "concealing this intelligence is a fraud; wherefore I decree "that the policy be delivered up with coſts, but the premium "to be paid back, and allowed out of the coſts." 2 *eq. Abr.* 635. *Weaver contra Fowler.* In the following term, the ſame point was again determined by Lord Macclesfield.

2. Seaman *contra* Fonereau, Eaſter term 1743, before Lord Chief Juſtice Lee in the King's-bench. A fleet of ſhips came out of port together, and afterwards anchored; it was agreed among all the captains of the fleet to keep company. Mr. Seaman's captain went on board one of the ſhips at anchor, and there dined. In diſcourſing at dinner, he ſaid, his ſhip was leaky, and a bad ſailer, and that ſhe could not keep company. After dinner the captain went on board his own ſhip, and at night a ſignal was given to ſail; but Seaman's captain intending to get ahead of the fleet, ſlipped away when under ſail, and arrived ſafe on the coaſt of England, where he was taken by a privateer.——The captain of the veſſel in which Seaman's captain had dined, apprehending the ſhip was foundered, wrote home, that ſuch a ſhip ſailed with them, but that in the night on a ſudden his lights diſappeared, and therefore he had reaſon to think ſhe had foundered. This advice reached Seaman time enough to make inſurance, but he concealed it from the underwriters; wherefore when the cauſe came to be heard, although the accident contained in the advice did not happen, the Lord Chief Juſtice Lee gave a verdict for the defendant. *Stran.* 1183. 16 *Geo.* II.

3. An.

3. An action was brought upon a policy of insurance, bearing, *inter alia*, "That the said ship, *&c.* for so much "as concerned the assureds, was and should be valued at in- "terest or no interest, free from average, and without bene- "fit of salvage, without farther account to be given by the "assureds for the same, touching the adventures and perils," *&c. communi forma*, because the insurers refused to make satisfaction for the loss.——The defendant pleaded the general issue, *Non assumsit*, and issue was thereon joined.

Upon this case it was clearly taken, at the trial before Lord Chief Justice Lee, without any objection or question made upon it, that the plaintiff was well entitled to maintain this action upon the policy of insurance made in the name of Caleb Smith, who was the policy-broker employed to procure the insurance, he having, by indorsement upon the policy, acknowledged and declared, that the policy was made in his name, upon the account, and for the sole risk and benefit of the plaintiff; and Smith was allowed, without any objection, to prove the underwriting by the defendant, and his own indorsement. In this case, the defence insisted on for the defendant underwriting the policy was, that the plaintiff had been informed by a letter wrote from Carolina, by a ship called *the Collet*, to one Mr. Crockat, that the Polly, the ship insured, had sailed ten days or a fortnight from Carolina before the ship Collet, and that the ship Collet had arrived in England about seven days before the insurance made, and that the plaintiff had not informed the defendant of this; which was insisted on to be a fraud in the plaintiff, sufficient to discharge the defendant of this insurance; it being, as was insisted, a settled and established rule, that, on making an insurance, all material circumstances relating to the adventure ought to be disclosed to the insurer, for him to judge upon; and the Chief Justice allowed this rule, and declared his opinion, that the concealment insisted on, was a sufficient circumstance to discharge the defendant from the policy; for he said, that these contracts are made upon a mutual faith and credit, and that to conceal such circumstances, which may make any difference in the adventure, is fraudulent: for the insurer ought to have the advantage of judgement upon them; and that where there is such concealment, the insurance ought not to bind.——But the defendant not being able to make out this fact to the satisfaction of the jury, the plaintiff had a verdict.

N. B. In this case the insurance was a re-insurance; and it

it was ſaid by ſeveral policy-brokers, that when policies are made intereſt or no intereſt, it is generally in ſuch caſes of re-inſurances. *Tr. & Com.* 148. *16th December* 1743, *at Guildhall, book* 5. *Thurmond.*

4. In the year 1678, one Newnham Perkins and Stoakes were owners of a veſſel, called *the May-flower ketch*; the veſſel coming laden with wines on the account of Firebrace and Stone to the iſle of Wight; Perkins being then in the ſame place, contrives, with one Joy the maſter, to ſell the freighters goods privately, and that being effected, to go out to ſea, ſome ſmall diſtance from the iſle, and there privately ſink the veſſel, and pretend ſhe ſtruck, and then foundered through ſtreſs of weather. The plot being laid, Perkins haſtens up to London, and makes a policy of inſurance on the veſſel; which being done, he remits his orders to Joy, to put the contrivance in execution; who accordingly, having diſpoſed of the beſt part of the goods, ſtood out to ſea, and then with his own hands, by the force of an iron crow, made a hole in the hold, and then in the long boat conveyed himſelf and mariners aſhore. Joy ſends advice of the loſs; and Perkins, as if he had known nothing of the matter, demands the monies aſſured, with great confidence, and thereupon brings an action for the ſame; but before the cauſe came to be heard, Firebrace and Stone bring trover againſt Perkins, and thereupon the whole fraud was detected, and judgement given for the plaintiff; with this further intimation, that if the owners proceeded in their action on the inſurance, they muſt expect that their practice and fraud would totally poiſon it; ſo they thought it adviſeable to drop it. *Molley, book* 2. *c.* 7. § 5.

5. The ſhip Charming Peggy was inſured in 1739 from North Carolina to London, with a warranty againſt captures and ſeizures, and in an action the loſs was ſaid to be by ſinking at ſea. All the evidence given was, that ſhe ſailed out of port on her intended voyage, and has never ſince been heard of. Several witneſſes proved, that in ſuch a caſe the preſumption is, that ſhe foundered at ſea, all other ſorts of loſſes being generally heard of. The underwriter inſiſted, that as captures and ſeizures were excepted, it lay upon the aſſured to prove the loſs in the particular manner declared on. But the Chief Juſtice ſaid, it would be unreaſonable to expect certain evidence of ſuch a loſs, as where every body on board is preſumed to be dead; and all that can be required is the

beſt

beſt proof the nature of the caſe admits of, which the plaintiff hath given. He therefore left it to the jury, who found the loſs according to the plaintiff's declaration. *Stran.* 1199. 17. *Geo.* II. *Green ver. Brown.*

6. The defendant inſured goods to London, and until the ſame ſhall be ſafely landed there. The ſhip arrived in the port of London, and the owner of the goods ſent his lighter and received the goods out of the ſhip; but before they reached land, an accident happened whereby the goods were damaged; for which this action was brought againſt the inſurer. For the defendant it was inſiſted on, that the accident happening after the owner had taken the goods into his poſſeſſion, it was a loſs after the inſurance was ended. To which it was anſwered, that if this had been an action againſt the maſter or owners of the ſhip, that would have been of weight, for they were certainly diſcharged; but in this action it could be no anſwer, for during all the voyage it might as well be ſaid that the goods were in the poſſeſſion of the aſſured, who took the ſhip to freight, and whoſe ſervant the maſter was, to this purpoſe, as much as the lightermen. And theſe words are put into policies, to guard againſt all ſorts of loſſes till there is an actual landing; becauſe, in the caſe of ſhips of great burden, that are forced to lie off, there may be a carriage for many miles in boats or lighters, and it was in the courſe of trade for the owner to ſend his lighters. But the Chief Juſtice held the inſurer was diſcharged. He ſaid it would have been otherwiſe had the goods been ſent by the ſhip's boat, which is conſidered as a part of the ſhip and voyage. And the jury, which was of merchants, expreſſing they thought it turned upon that diſtinction, brought in a verdict as to this point againſt the plaintiff. *Strange* 1236. 18. *Geo.* II. *Sparrow ver. Carrouthers.*

7. The ſhip Succeſs was inſured at and from Leghorn to the port of London, and till there moored twenty-four hours in good ſafety. She arrived the 8th of July at Freſh wharf, and moored; but was the ſame day ſerved with an order to go to the Hop to perform a fourteen days quarantine. The men upon this deſerted her, and on the 12th the captain applied to be excuſed going back; which petition was adjourned to the 28th, when the regency ordered her back; and on the 30th ſhe went back, performed the quarantine, and then ſent up for orders to air the goods. But before ſhe returned, the ſhip was burnt on the 23d of Auguſt; and now the queſtion

was, whether the inſurers were liable? For the defendant it was inſiſted, that the ſhip arriving and being moored on the 8th of July, and remained ſo till the 30th, here was a performance of what he had undertaken, and his riſk ought not to be extended to ſo long a time as from the 8th of July to the date of burning, the 23d of Auguſt. But it was ruled, that though the ſhip was ſo long at her moorings, yet ſhe could not be ſaid to be there in good ſafety, which muſt mean the opportunity of unloading and diſcharging; whereas here ſhe was arreſted within the twenty-four hours, and the hands having deſerted, and the regency taking time to conſider the petition, there was no default in the maſter or owners; and it was proved, that till the fourteen days were expired, there could be no application to air the goods; wherefore the jury found for the plaintiff. *Strange* 1243. 19. *Geo.* II. *Waples ver. Eames.*

8. Upon the execution of a writ of inquiry, before the Chief Juſtice, it appeared, that the defendant was an inſurer to *L.* 200 upon corn, the value of which was *L.* 217; that the corn was ſo damaged in the voyage that it ſold only for *L.* 67, and the freight came to 80; and upon this the queſtion was, whether as the freight, which the plaintiff was obliged to pay, exceeded the ſalvage, this was not to be conſidered as a total loſs? And for the plaintiff it was inſiſted, that he ought not to be in a worſe condition than if his corn had gone to the bottom of the ſea; for then he would have had no freight to pay, and now that the voyage hath been performed, whereby the freight is become due, he hath a right to apply the ſalvage for diſcharging that. It was proved to be the uſage, where the ſalvage exceeds the freight, to deduct the freight out of the ſalvage; and make up the loſs upon the difference. For the defendant it was inſiſted, that as his inſurance was upon the corn, and the whole did not periſh, he ought, in making up the loſs, to deduct the ſalvage: but no inſtance could be ſhown, on either ſide, of an adjuſtment where the freight exceeded the ſalvage. The Chief Juſtice was of opinion, that ſince it was uſual to deduct the freigh when the ſalvage exceeds it, the plaintiff was in this caſe wherein it fell ſhort, entitled to have it conſidered as a tota loſs, and the jury found for the plaintiff accordingly. *Strange* 1065. 10. *Geo.* II. *Bayfield ver. Brown.*

9. The plaintiff inſured on ſhip and freight at and from Jamaica to Briſtol. A cargo was ready to put on board, but

as the ſhip was careening in order for the voyage, a ſudden tempeſt aroſe, and ſhe and many others were loſt. The rigging and part of her were recovered and ſold, and the defendant paid in to court as much as upon an average he was liable to for the loſs of the ſhip. But the plaintiff inſiſted to be allowed *L.* 600 for the freight of the ſhip, which ſhe would have earned in the voyage, if the accident had not happened. But as the goods were not actually on board, ſo as to make the plaintiff's right to freight commence, the Chief Juſtice held he could not be allowed it. 19. *Geo.* II. *Strange* 1251. *Tongue ver. Watts.*

10. A bill in chancery was brought for relief againſt a verdict and judgment given in the court of common pleas, upon a policy of inſurance, and to have an injunction to ſtay execution upon the judgement. The caſe appeared to be, that the ſhip inſured was taken by a Spaniſh privateer, and that after it had been carried *infra hoſtium præſidia*, it was retaken by an Engliſh privateer. It was argued for the now plaintiff, who was the defendant at law, that although, by the law of nations, the firſt capture of the ſhip, and its being *infra haſtium præſidia*, had abſolutely diveſted the right of the original proprietors, yet that now, by the ſtatute made in the year 1740, it is otherwiſe, being thereby provided, that if the ſhips of our Engliſh merchants ſhould be taken by an enemy, and afterwards retaken by any of his Majeſty's ſubjects, that the right of the original proprietors in ſuch ſhips ſhould be reſerved, on their paying one moiety of the value of ſuch ſhips to the recaptors for reſalvage. Upon this it was argued, that the verdict and judgement are unjuſt, in regard that the whole inſurance money is given in damages, when it appears that the plaintiff at law, upon payment of half of the value of the ſhip, might recover it back, and therefore that half of the inſurance money ought only to have been given in damage, upon which the injunction prayed by the bill was moved for. On the other ſide it was inſiſted, that this was a right verdict, and that the inſured were not to be put to the delay, expenſe, and trouble of aſcertaining the value of the ſhip, in order to recover it back, upon payment of one moiety of the value to the captors; that for recovery thereof the inſurers might ſtand in the place of the inſured, and make uſe of their names, which had been offered; that they did not pretend to oppoſe ſo much of the bill as ſought this, but inſiſted, that this could be no ground for granting the injunction prayed: that this point hath been debated before Lord Chief

Chief Juſtice Willes, upon trial of the iſſue at *Niſi prius*, who had declared his opinion, that this right of ſalvage ought not to preclude the inſured from their recovery upon the inſurance till the ſalvage ſhould be ſettled: that the defendants the inſurers would be entitled to ſtand in the place of the inſured, to make what advantage they could of the ſalvage. Lord Hardwicke Chancellor being of the ſame opinion, refuſed to grant the injunction, and ſaid, that the damage in recovering the ſalvage is as much a part of the inſurance as the ſhip itſelf. *Dict. trad. & com.* 148. *Mich.* 18. *Geo.* II. *Prendle ver. Hartly.*

11. A ſhip inſured was in her voyage ſeized by the government, and converted into a fireſhip; the queſtion was, whether the inſurers were liable? Holt Chief Juſtice thought it was within the word *detention*, but the cauſe was referred. 2 *Salk.* 444.

12. In a caſe on a policy of inſurance upon *Non aſſumſit* pleaded. The caſe was, Mr. Criſp being at the Weſt Indies, ſent a letter to Bates to inſure goods on the Mary galley of St. Chriſtopher's, Capt. A. Hill commander, at London. Bates carried the letter to Stubbs, who writ policies, and he by miſtake made the inſurance on the Mary, Capt. Haſlewood commander, *&c.* This policy thus made was ſubſcribed by the defendant. The Mary galley was loſt, and then Stubbs applied to the inſurers to conſent to alter the policy, to which they agreed, and the miſtake was rectified. It was objected at the trial, that the Mary was a ſtouter ſhip than the Mary galley, and that the inſurers ought to have an increaſe of premium for the alteration: but it was held by Holt Chief Juſtice, that the action well lay, and that the miſtake might be ſet right, and that Stubbs was a good witneſs; and he cited this caſe which happened when Pemberton was Chief Juſtice: An inſurance was made from Archangel to the Downs; and from the Downs to Leghorn, but there was a parole-agreement at the ſame time, that the policy ſhould not commence till the ſhip came to ſuch a place. It was held the parole-agreement ſhould not void the writing. 2 *Salk.* 444. *Dec.* 3. 1703. *Bates ver. Graham & alios, at Guildhall.*

13. *Aſſumſit* upon a policy of inſurance, where the defendant inſured the plaintiff intereſt or no intereſt, againſt all enemies, pirates, takings at ſea, and all other damages whatſoever. And upon trial it appeared, that the ſhip was taken

by a pirate of Sweden, and was in his poſſeſſion for nine days, and then retaken by an Engliſh man of war, and after the ſuit commenced brought into Harwich. And the queſtion was, whether in ſuch caſe the defendant was reſponſible? It was reſerved by the Chief Juſtice for the opinion of the court; and after argument by Serjeant Whiteacre for the plaintiff, and by Dr. Henchman for the defendant, it was determined for the plaintiff. For although it was objected, that the inſurer was only reſponſible where the plaintiff had a property, and that the term of inſuring intereſt or no intereſt was introduced ſince the revolution; yet it was ſaid, that ſuch inſurance was good, and the import of it is, that the plaintiff has no ocaſion to prove his intereſt, and that the defendant cannot controvert it.

And though the ſhip was here retaken, yet the plaintiff received a damage, for his voyage was interrupted; and the queſtion is not, whether the plaintiff had his ſhip, and did not loſe his property, but what damage he ſuſtained. *Comyns* 360. *Mich.* 7. *Geo.* I. *Depaba ver. Ludlow.*

French ordinance of 1681, *concerning inſurances.*

1. TO all our ſubjects, and even to foreigners, we allow to inſure, and have inſurance made, in our dominions, on ſhips, goods, and other effects that may be carried by ſea, or navigable rivers; and to the inſurers, to ſtipulate and fix a price, for the conſideration whereof, they take on themſelves the riſk.

2. The contract called *the policy of inſurance*, ſhall be drawn up in writing, and may be executed as a private deed.

3. The policy ſhall contain the name, and the place of reſidence of the perſon who has the inſurance made, whether he be the proprietor of what he inſures, or acts as a factor; the effects whereon the inſurance ſhall be made; the name of the veſſel, and the maſter; the place where the goods have been or ſhall be laden; the port whence the ſhip ſhall depart, or is departed, where ſhe ſhall load and unload, and thoſe ſhe may touch at; when the riſk ſhall begin, when end; the ſum inſured; the premium or coſt of the inſurance; a declaration that the inſurer or inſured, agree to ſubmit to arbitration, any difference that may ariſe; and generally, all other clauſes and conditions which they may have agreed to inſert.

4. Never-

4. Nevertheleſs, inſurance may be made without declaring the name of the maſter, or the veſſel, or cargo, which may come into Europe, from Turkey, the coaſt of Africa, or other parts of the world, provided that the name of the perſon to whom they may be conſigned, be declared in the policy.

5. If the policy do not fix the time when the riſk ſhall begin and when end, it ſhall be as ſet forth in the 13 article of the chapter relating to bottomry-contracts *.

6. The premium or coſt of the inſurance ſhall be paid in full, upon underwriting the policy; but if inſurance be made on goods out and home, and that the ſhip being arrived at the outward-bound port do not return, the inſurer ſhall repay one third of the premium, except it be otherwiſe covenanted.

7. Inſurances may be made on the hull and keel of a ſhip, empty or laden, before or on the voyage, on victualling, and on goods jointly or ſeparately laden in a ſhip of defence, or not ſo; alone, or in company with other veſſels; out or home; for a whole voyage, or a limited time.

8. If inſurance be made on the hull and keel of a ſhip, her tackle, apparel, filling, and victualling, or on a part thereof, the valuation ſhall be made in the policy. The inſurer, nevertheleſs, in caſe of fraud, may inſiſt upon a new valuation.

9. All ſeamen, paſſengers, and others, may have inſurance made on themſelves againſt ſlavery: In this caſe the policies ſhall contain the name, country, place of abode, age, and quality of the perſon whereon inſurance is made; the name of the ſhip, of the port ſhe departs from, and whither ſhe is ultimately bound; the ſum which ſhall be paid in caſe of capture, as well for the ranſom, as for the charges of return; to whom the money ſhall be paid; the penalty for non-payment.

10. We forbid making inſurances on the lives of any perſons.

* The article alluded to is as follows: If the time the riſk is to continue, be not ſtipulated by the contract, with regard to the veſſel, tackle, apparel, and victualling, it ſhall begin and run from the day ſhe ſhall have ſailed, till ſhe be at anchor at her intended port, and there moored to the quay. And as to the goods, the riſk runs from the time of their being ſhipped, or in the lighters to carry them on board, until they are landed.

11. Thoſe

11. Thoſe, however, who ſhall redeem captives, may inſure on them the price of their ranſom, which the inſurers ſhall pay, if in their way back, they be retaken, killed, drowned, or if they die otherwiſe than by a natural death.

12. Women may lawfully engage themſelves, and their dowers, to get their huſbands out of ſlavery.

13. He who, on a wife's refuſal, and being juridically authoriſed, ſhall lend money for the ranſom of a ſlave, ſhall have preference of the wife on the huſband's effects, except in reſpect to her dower.

14. Minors with the advice of their guardians may do the ſame to releaſe their fathers from ſlavery, and they ſhall not have any pretenſions for reſtitution.

15. The owners of ſhips, and the maſters, ſhall not have inſurance made on the freight their veſſels may make; nor ſhall the merchants on an expected profit on their goods, nor ſea-faring men on their hire.

16. We expreſsly forbid thoſe who may take up money on bottomry, to have inſurance made thereon; under the penalty of the ſame being declared invalid, and of corporal puniſhment.

17. The lenders on bottomry, under the ſame penalty, ſhall not inſure the profit on the ſum lent.

18. The inſured ſhall always run one tenth part riſk of the value of the effects laden, except in the policy it be expreſsly declared, that the whole is to be inſured.

19. If the inſured be on board the ſhip, or be the owners of her, though they declare that they inſure the whole, yet ſhall they be obliged to run one tenth part of the riſk.

20 It ſhall be lawful for inſurers to have reinſurance made on the effects by them inſured; and to the inſured, to have inſurance made on the coſt or premium of the inſurance, and the ſolvability of the inſurers.

21. The premiums of the reinſurance, may be either more or leſs than thoſe of the inſurance.

22. We forbid making any inſurance or reinſurance on goods or effects above their value, in one or more policies, under the penalty of ſuch inſurance being invalid, and confiſcation of the goods.

23. If nevertheleſs a policy be made, without a fraudulent intention, wherein the valuation of the effects exceeds their real worth, that policy ſhall be valid to the amount of their intrinſic value; and in caſe of loſs, the inſurers ſhall be anſwerable for the ſame, each in proportion to the ſums by them

them underwrote; as alſo to return the premium of the ſurplus value, retaining half *per cent.*

24. Moreover, if there ſhould be ſeveral policies made without a fraudulent intention, and the firſt policy amounts to the value of the effects laden, it ſhall alone hold good. The other inſurers ſhall withdraw their inſurance, and return the premium, keeping half *per cent.*

25. In caſe the firſt policy ſhould not contain the amount of the effects laden, the inſurers on the ſecond ſhall be anſwerable for the ſurplus. If there be effects laden to the amount of all the inſurance made, then, in caſe of loſs of a part, it ſhall be paid by all the inſurers, ſo much *per cent.* on what they have underwrote.

26. Inſurers ſhall be anſwerable for all loſſes or damages which ſhall happen at ſea by tempeſt, ſhipwreck, ſtranding, running foul of other ſhips, changing the courſe, or the voyage, or the ſhip; jettiſon, fire, capture, plundering, detention of princes, declaration of war, repriſals, and generally all other accidents of the ſea.

27. However, if the change of the courſe, the voyage, or the ſhip proceed from an order of the inſured, without the conſent of the inſurers, they ſhall not be anſwerable for the riſks. Moreover, this ſhall likewiſe hold good in regard to all other loſſes, or damage, which may happen by the act or fault of the inſured; nor ſhall the inſurers be obliged to return the premium, if they have begun to run any riſk.

28. Nor ſhall the inſurers be anſwerable for the loſs or damage that may happen to ſhip or goods, through the fault of the maſters, or mariners, if by the policy they be not liable to the barratry of the maſter.

29. The loſs, diminution, or waſte, that may happen from the periſhable quality of any thing, ſhall not fall on the inſurers.

30. Nor ſhall they be anſwerable for pilotages, warpings in, cuſtomhouſe-dues, reports, anchorages, or any other dues or impoſitions on ſhip or goods.

31. In the policy ſhall be ſpecified thoſe goods that are ſubject to leakage; without which the inſurers ſhall not be anſwerable for the damage that may happen to them by ſtorm; except the inſurance be made upon returns from foreign countries.

32. If an inſurance be made and particulariſed to be on ſeveral ſhips, and the whole of what was to be loaded be put in one ſhip, the inſurer ſhall not be anſwerable for more than

than he may have underwrote on the particular ſhip, though all the others ſhould happen to be loſt, and he ſhall return the premium of the overplus, reſerving half *per cent.*

33. When the maſters of veſſels have orders to touch at different ports, the inſurers ſhall not be liable to accidents that may happen to goods on ſhore, though they were deſtined for the cargo of the ſhip on which they underwrote, and ſhe was in port to take them in, except there be a particular agreement in the policy.

34. If inſurance be made for a fixed time, without declaring the voyage, the inſurer, when that term is elapſed, is free from his obligation, and the inſured may get a new inſurance done.

35. But if the voyage be declared in the policy, the inſurer ſhall run the whole riſk of the voyage, provided that there be an augmentation of premium, in caſe the voyage be longer than the time limited. In caſe the voyage be leſs, the inſurers ſhall not return any premium.

36. Inſurers ſhall be exempted from the riſk, yet ſhall get the premium, if the inſured, without their conſent, ſend a ſhip to a port at a greater diſtance than what is mentioned in the policy, though it be in the ſame courſe; but an inſurance ſhall fully hold good, if the voyage be only ſhortened.

37. If by the inſured, the voyage be broke before the departure of the ſhip, the inſurance ſhall be made void, and the inſurers return the premium leſs one half *per cent.*

38. We declare void the inſurance that may be made after the loſs of the arrival of things inſured, provided the inſured knew, or could know the loſs, or the inſurers the arrival before the underwriting of the policy.

39. It ſhall be preſumed, that the inſured knew of the loſs, and the inſurer of the arrival, if the news thereof could have been brought from the place of the loſs, or of the arrival, ſince it happened; reckoning at the rate of a league and half in an hour, excluſive of other proofs that may be alleged.

40. If, however, the inſurance be made on good or bad news, it ſhall ſubſiſt, except it ſhall be proved, excluſive of the allotted time of a league and a half in an hour, as above; that the inſured knew the loſs, and the inſurer the arrival of the veſſel, before the underwriting of the policy.

41. The inſured, if it be proved againſt him, ſhall repay

to the inſurer what he may have received, and double premium. And if proof be made againſt the inſurer, he ſhall repay the premium, and twice that ſum to the inſured.

42. When the inſured ſhall receive advice of the loſs of a ſhip, or of goods inſured, of the detention by princes, and of any other accidents for which the inſurers are anſwerable, he ſhall forthwith ſignify and make known the ſame to them, proteſting that he ſhall make a ceſſion or abandon to them at a proper time.

43. The inſured may, inſtead of ſuch proteſtations, at once make his ceſſion or abandon, and ſummons the inſurers to pay the ſum inſured, as ſtipulated by the policy.

44. If the term for payment be not fixed by the policy, the inſurer ſhall be obliged to pay the inſurance in three months after intimation of the abandon.

45. In caſe of ſhipwreck or ſtranding, the inſured may endeavour, and work at the ſaving of the goods, without prejudicing himſelf as to any ceſſion or abandon which he may afterwards make; he ſhall alſo be repaid his charges, the account of which ſhall be credited on his oath, to the amount of the value of what may be ſaved.

46. No ceſſion or abandon ſhall be made, except in caſe of capture, ſhipwreck, ſtranding, detention by princes, or the entire loſs of the goods inſured; and all other damages ſhall be reputed to be average, which ſhall be ſettled between the inſurers and the inſured, according to their ſeveral concerns.

47. No ceſſion or abandon ſhall be made of a part of any concern or intereſt, and the remainder kept; nor ſhall there be a demand for average, except it exceed one *per cent*.

48. All ceſſions, or abandons, as well as all demands in virtue of the policy, ſhall be made as follows:

In ſix weeks, for loſſes happening on the coaſts of the country where the inſurance was made.

In three months, in other provinces of our kingdom.

In four months, on the coaſt of Holland, Flanders, and England.

In a year, in Spain, Italy, Portugal, Barbary, Muſcovy, Norway; and in two years, for the coaſts of America, the Braſils, Guinea, and other diſtant countries. When theſe terms ſhall be elapſed, the inſured's demands ſhall not afterwards be admitted.

49. On the detention by princes, the ceſſion or abandon

ſhall not be made before ſix months, if it happen in Europe, or in Barbary; if in a more diſtant country, in a year; both to commence from the day of the notifying this detention to the inſurers. The non-admittance of the inſured's demands in the preceding article, ſhall only, after theſe terms elapſed, take place.

50. Nevertheleſs, if goods detained be of a periſhable nature, the ceſſion or abandon may be made after ſix weeks, if they be ſtopped in Europe, or in Barbary; and after three months, if in a more diſtant country, from the day of the notification of ſuch detention to the inſurers.

51. The inſured ſhall be obliged, during the terms mentioned in the two preceding articles, to uſe their utmoſt diligence for the clearing or taking off the detention. And even the inſurers themſelves may do the ſame if they think fit.

52. If a ſhip be ſtopt by our orders, in any of the ports of our kingdom, before the voyage be begun, the inſured ſhall not, on account of this detention, abandon or cede their effects to the inſurers.

53. The inſured ſhall be obliged, when he makes his ceſſion or abandon, to declare all the inſurances he may have made, and what money he may have taken on bottomry, on the effects he has inſured; under the penalty of invalidating his inſurances.

54. If the inſured ſhall ſecrete either inſurances, or bottomry-contracts, and that thoſe, together with what he may have declared, do exceed to the value of the effects inſured, the inſurances ſhall be void, and the inſured obliged to pay the ſum borrowed, though the ſhip be taken or loſt.

55. Moreover, if he ſues for the payment of the ſum inſured, above the value of his effects or intereſt, he ſhall be exemplarily puniſhed.

56. Inſurers on a cargo ſhall be obliged to pay the ſums by them underwritten, only to the amount of what the inſured ſhall prove the ſhipping and the loſs of.

57. The proofs of the ſhipping, and loſs of the effects inſured, ſhall, immediately after the notification of the ceſſion or abandon, be communicated to the inſurers; who, before ſuch notification, ſhall not be liable to be ſued for the payment of the ſums inſured.

58. Nevertheleſs, if the inſured receive no news of his ſhip, he may, at the expiration of a year for common voyages, reckoning from the day of the departure, and after

two

two years, for thoſe at a greater diſtance, make his ceſſion or abandon to the inſurers, and demand payment, without being obliged to produce any certificate of the loſs.

59. Voyages from France to Muſcovy, Greenland, Canada, Newfoundland, its iſlands and banks, and other coaſts and iſlands of America to Cape Verde, and the coaſt of Guinea, and all others which may be made beyond the tropic, ſhall be reputed long voyages, or at a great diſtance.

60. After the ceſſion or abandon is made, the effects inſured ſhall belong to the inſurer, who ſhall not, under the pretence of waiting for the return of the ſhip, put off the payment of the ſums inſured.

61 The inſurer ſhall be allowed to produce proofs againſt any documents the inſured may give; nevertheleſs, he ſhall in the mean time pay the ſum by him underwrote, upon the inſured's giving ſecurity.

62. The maſter who may have inſurance made on goods loaden in his veſſel, ſhall, in caſe of loſs, be obliged to prove the buying of them, and produce a bill of loading ſigned by the purſer or mate.

63. All ſeafaring men who bring goods from abroad to France, and there have inſurance made, ſhall be obliged to leave a bill of loading in the hands of the conſul or his chancellor, if any, where the goods are loaden; if no conſul, then in the hands of a reputable French merchant.

64. The value of goods ſhall be proved either by book or invoice; if not they ſhall be eſtimated according to the price which was current at the place when and where ſhipped, including all cuſtoms and charges till on board, except in the policy a valuation of them be made.

65. If the inſurance be made upon return from a country where trade is carried on by barter, the valuation of thoſe returns ſhall be made on the coſt of thoſe given in barter, adding thereto all charges.

66. In caſe of capture, the inſured may ranſom their effects, without waiting for orders from the inſurers, if they could not adviſe them of it. They however ſhall be obliged to let them know afterwards in writing, what ſum was paid for the ranſom.

67. The compoſition for the ranſom, the inſurers may take on themſelves in proportion to their concern; in which caſe, they ſhall be obliged to declare immediately, that they will contribute towards the payment of the ranſom, and will run the riſk of the return; if not, they ſhall pay the ſum

by them insured, and have no pretensions on the effects ransomed.

68. We prohibit all police-clerks, secretaries of insurance-chambers, notaries, or brokers, to have polices underwrote, in which any thing is left in blank, under the penalty of costs or damages; nor shall they be concerned in insurances directly or indirectly themselves, or by other persons, or take any cession of the rights and interest of the insured, under the penalty of five hundred livres for the first time, and in case of recidivation, to be deprived of their employment: which penalties shall not be in any manner moderated.

69. We injoin under the above penalty, that they keep a proper register marked on every leaf, by the lieutenant of the admiralty, wherein they shall keep an account of the policies they shall draw up.

70. If in the policy there be a declaration that any dispute shall be left to arbitration, and one of the parties demand arbitrators before any litigation be begun, the other party shall be obliged to agree to it; and refusing to name them, the judge shall do it.

71. In eight days after the arbitrators are named, the parties shall produce their documents; and in eight days after that, shall sentence be given.

72. Such awards by arbitration shall be registered or ratified in the court of the admiralty where they were made. We prohibit the judge thereof, under any pretence whatsoever, to take cognisance of the merits of the cause, under pain of nullity, and the penalty of damages and costs.

73. Any appeal from an award by arbitration after the registering thereof, shall be to our parliaments, where, until the amount of the sentence be paid, it shall not be received.

74. If security be given to the judges who register the sentence of arbitration, the same shall be executed, notwithstanding the appeal.

Ordinance of insurance and averages of the city of Amsterdam, of the year 1744.

WHEREAS the worshipful gentlemen of the judicature of the city of Amsterdam, have experienced, that since the publication of the statutes or ordinances of insurance and averages, and the amplifications thereof, many alterations have from time to time happened in trade; whence sundry

matters

matters and articles require to be altered, explained, or amended: therefore the ſaid gentlemen, after advice taken concerning trade, inſurances, and averages, and on the information of many eminent merchants and underwriters, have thought proper, by virtue of the privileges of this city, and of the letters of grant, approbation, and confirmation granted, *ex abundanti*, by their High Mightineſſes to the ſaid city, on the 17th of July 1612, to confirm, enlarge, and explain the aforeſaid ordinances, and the amplifications thereof; and farther to ordain, enact, and inſtitute, as by theſe preſents is ordained, enacted, and inſtituted, that in matter of inſurances and averages henceforth ſhall be obſerved and regarded what here follows.

1. Firſt, it is ordered, that all ſtipulations or conditions inſerted in any policies of aſſurance which are contrary to this ordinance, ſhall be deemed void, and of no value, notwithſtanding the contracting parties ſhould renounce all benefit from this ordinance.

2. The inſtrument of aſſurance-policy, is to contain the name of the ſhip, that is to ſail or depart from theſe countries, to other countries or kingdoms, or that is expected to come from any foreign parts to theſe or other countries and kingdoms; and likewiſe the name of the captain, or maſter, that ſhall have the command of the ſhip, unleſs the ſame be not known: in which caſe it muſt be mentioned in the policies; and the name of the perſon that gave the order or advice muſt be expreſſed, together with the date of the letter of advice, in which the order is given, under the penalty of being of no value; and no return of premium is to be demanded of ſuch an aſſurance, unleſs the names of the ſhipper, or whomſoever elſe has the direction, as likewiſe the name of the parties to whom the goods go conſigned, are expreſſed in the policy: and in that ſame inſtrument are likewiſe to be mentioned the name of the place where the ſaid ſhip or ſhips are to be loaded, and where they are bound to; likewiſe under the penalty, that ſuch an obligation of aſſurance ſhall be void and of no effect, if the fault proceeds from the party that is inſured: but otherwiſe the aſſured is to ſeek his redreſs from the perſon that drew up the inſtrument, for ſo far as the defect or fault lies with him; provided, however, that, with reſpect to the place of ſhipping, it ſhall only be neceſſary to expreſs the ſame in caſes when the goods are ſhipped from a different place, than from where the riſk of the aſſurance is to take its beginning. Further,

ther, in making aſſurances upon the hull of ſhips, as likewiſe upon bottomry money, either upon ſhips, or goods, it ſhall not be requiſite to mention the places of loading.

3. It ſhall alſo be lawful to make inſurance on goods and on ſhips already departed from the place of their lading, provided the time of their departure be inſerted in the policy, without adding thereto; "but departing ſooner or "later ſhall not prejudice," which is hereby ſpecially forbidden: in caſe the inſured has no farther knowledge of the departure by a letter of advice, he ſhall be deemed ignorant thereof; but ſhall expreſs in the policy, the place and date of the letter of order, on pain of nullity; and ſhall moreover be obliged to confirm this his ignorance upon oath, in caſe of diſaſters or loſſes; ſaving to the underwriters, the liberty of proving the knowledge of the inſured; and evident proof thereof appearing, the inſured ſhall not only have no action againſt the underwriters, but ſhall alſo be obliged to pay them a double premium over and above the charges paid by them to come at the ſaid proofs; and it ſhall be lawful for the high ſheriff to proceed againſt ſuch inſureds, as againſt treacherous perſons.

4. By parts circumjacent to the place from whence the inſurance ſhall begin, is underſtood not only the place of lading, but alſo all the creeks and harbours, the buoys, beacons, and all ſuch like marks, in caſe there be any, which the ſhip muſt paſs.

5. The riſk of the underwriters of goods, ſhall commence from the time the goods inſured are brought on the key, or to the ſea-ſhore, from thence to be conveyed, in boats, barks, or lighters, on board of the ſhips that are to tranſport them; and ſhall continue till the ſhips be arrived at the deſtined place, and the merchandiſes inſured be unladen on the key or ſhore. But in caſe the inſured neglect to unlade the goods, or think proper to make uſe of the ſhip inſtead of a warehouſe, then the riſk of the underwriters ſhall end fifteen days after the arrival of the ſhip, excepting that, by lawful hindrances or obſtacles, they could not have been unloaded in that ſpace; which, in caſe of diſaſters or damages, ſhall be proved.

And in regard to the hull or body of the ſhip, the riſk of the underwriters ſhall commence when the maſter has made a beginning of lading of merchandiſes, or has taken in ballaſt for the inſured voyage, and end one and twenty days after the ſhip ſhall be arrived at the deſtined place, or ſo-

much

much ſooner, as ſhe ſhall be entirely unladed. But inſurance being made on the hull for going and coming, that is, for the voyage out and home, the riſk for the underwriters ſhall not ceaſe till the whole inſured voyage be ended.

6. The inſured on the cargo, may not cauſe the maſter whom he has freighted, to enter, or to make any other port, nor to alter his voyage, but according to the policy: otherwiſe the inſurance ſhall be null, although it had been inſerted in the policy, that he might touch at, and make all places any where; but the maſter may touch at other ports than thoſe mentioned in the policy, when neceſſity requires it: and doing otherwiſe, if it be without order of the inſured, the inſurance ſhall nevertheleſs remain valid; ſaving to the underwriters the right of having recourſe on the maſter. But if the inſurance be made for the owners or proprietors of the ſhip, it ſhall in ſuch a caſe be null.

7. The hull of the ſhip, with her maſts, yards, bowſprit, ſtanding and running rigging, anchors, cables, ſails, guns, ammunition of war, proviſions, and further appurtenances thereof, nothing excepted, even the premium of inſurance, and the monies given in hand incluſive, may be inſured to the full, and as it really coſt, as fitted out for ſea; and the owners or inſured ſhall have the liberty to value the ſhip with all her appurtenances in the policy, for the whole, or each for his ſhare, but not above the true value; and if no valuation is inſerted in the policy, or if the parties in caſe of loſs of average, diſagree about the value, as alſo if it was valued above its true value, then the commiſſioners ſhall make inquiry, and fix the valuation, and the underwriters may bring in their plea.

8. But he who cauſes himſelf to be inſured on the hull or body of a ſhip built of fir-wood, ſhall particularly inſert it in the policy, mentioning that ſhe is built of fir-wood, on pain, that otherwiſe the underwriters ſhall not be obliged to pay more than the half of the loſs that might happen. Every thing farther that concerns the inſurance upon the hull is decreed in the foregoing article.

9. Inſurance on goods, wares, and merchandiſes, monies, gold, ſilver, jewels, pearls, and other precious ſtones, going or coming by land, or over freſh water, (whereof hereafter, under No 5. a form of policy is found), may be regulated by the parties in manner as they amongſt them can agree, provided it be not contrary to this ordinance. Maſters may alſo cauſe their veſſels to be inſured.

10. But

10. But under the general denomination of goods, wares and merchandiſes ſhall not be underſtood to be comprehended gold, ſilver, coined or not coined, jewels, pearls, or precious ſtones, nor ammunition of war, and arms; and therefore, he who cauſes himſelf to be inſured thereon, ſhall be obliged to name and expreſs thoſe wares in the policy; as alſo if they are packed amongſt other goods, to mention it, or otherwiſe the inſurance ſhall be held to be of no validity.

11. It ſhall alſo be lawful to make inſurance on ſhips, goods, wares, and merchandiſes, which are ſunk, ſpoiled, robbed, taken, or arreſted, even after ſuch misfortune has happened, if no knowledge thereof is come to the principal who cauſes the ſame to be inſured, at the time of giving of the laſt order, or to him who gives order for making the inſurance, or to the correſpondent, broker, or others who have procured the ſaid inſurance, at the time of making it.

12. But when the ſhip or goods have been ſo long ſunk, robbed, ſpoiled, taken, or arreſted, that the knowledge thereof could have come to the perſon who maketh the inſurance, either by ſea, or by land, reckoning three miles to two hours, in ſuch caſe the inſurance ſhall be held of no value, except the inſured, and alſo thoſe who procured the inſurance for him, declare upon oath that they were ignorant of the damage and loſs at the making the inſurance.

13. The maſters, pilots, ſailors, warlike people, and all others who navigate the ſaid ſhips, ſhall not cauſe their hire or wages to be inſured, but their ranſom from pirates, and the merchandiſes they take along with them, they may inſure. No inſurance ſhall be made on wagers of voyages, and other ſuch like inventions; and no judgement ſhall be given on them. Neither ſhall inſurance be made on the ſhip's hull, or goods, before the ſhip ſhall lie at the place from whence one cauſes himſelf to be inſured, without ſpecially expreſſing it in the policy, that the ſhip was not yet there arrived on pain of nullity.

14. In inſurances on the bodies of maſters, mariners, and paſſengers, againſt infidels, and other pirates, the underwriters ſhall be obliged to pay the ſum they have underwritten, as ſoon as the bills of exchange drawn for the payment of the ranſom are accepted, or ſooner, if it appears that the perſon ranſomed is arrived on Chriſtian ground; but with this proviſo, that the full ſum inſured for the ranſom be laid out,

out, and, in caſe the perſon was ranſomed for leſs, that the overplus be returned.

15. The freight-money, (beſides the ordinary charges of averages ſo called,) after deduction of the wages of the crew, and further charges, which on navigating ſafe muſt be paid thereout, may be inſured for as much as can be juſtly made appear either by charter-party, manifeſt or bills of lading, that there will be got or loſt: and if a ſhip has laden goods for the proper account of owners, and they will inſure the freight, the freight ſhall be valued in the policy; and in default of that as by Art. VII. and XXII.

16. He who cauſes himſelf to be inſured on ſhip and lading, with intention, if taken by the enemy, to cauſe the ſame to be ranſomed or redeemed, ſhall be obliged to expreſs it diſtinctly in the policy, mentioning at what ſum order is given to the maſter, or him who hath the direction thereof, for the redeeming; in which caſe the underwriters muſt continue to run the riſk on ſuch ranſomed ſhip and goods, till they arrive at the deſtined place of unlading; and moreover be obliged to make good the ſum, with the charges which are paid for the perſon who is gone over as hoſtage for the ranſom, in the manner of a groſs average on ſhip and cargo; this ſerving as a foundation or rule, that when the ſhip is taken and ranſomed before ſhe has accompliſhed half her voyage, the goods ſhall be reckoned according to the real coſt; all charges, till on board, and the premium of inſurance included: and being advanced beyond half the voyage, then at what they would ſell for. And the ſhip ſhall at all times, be ranſomed before ſhe has made half the voyage, or after, be reckoned according to the valuation made in the policy.

17. The imaginary profit one promiſes himſelf on his intereſt in a cargo muſt be valued in the policy, with explication which goods it is expected from; but no returns of premium for the ſame ſhall be demanded.

18. Inſurance againſt fire, on rope-yards, ſugar-houſes, ſtill-houſes, mills, and other edifices, effects and utenſils, thereto belonging, as well in this country as abroad, as alſo on houſes and warehouſes, ſhall be permitted to be made by policy for one year.

19. Alſo inſurance ſhall be permitted to be made on monies given by the inſured to a mariner, maſter, or other perſon navigating on any voyage, on bottomry, or adventure of a voyage, with the premium included; provided the ſum

of money which is paid on bottomry be inſerted in the policy, as alſo the premium; otherwiſe the capital only ſhall be underſtood to be inſured

The inſured ſhall in caſe of loſs, either by the ſhip's being caſt away, taken, or detained by friends, or enemies, and her being miſſing a year and day, not be obliged to produce any other proof but only of the misfortune befallen the ſhip. and concerning his intereſt, only his bottomry bond; provided the inſured, on being paid made over to the underwriter all claim on the taker on bottomry, and deliver up to him the writings thereto belonging.

The inſured ſhall be obliged to inſert in the policy the name of him to whom the money on bottomry is given, alſo the name of the ſhip with which the taker on bottomry ſhall navigate, the name of the maſter, as alſo whither the ſhip is bound, on pain of nullity.

If during the voyage the ſame is altered by the maſter not by means of the taker of the money on bottomry, the underwriter ſhall notwithſtanding, in caſe of loſs, be obliged to pay his engagements.

But the money on bottomry being given to the maſter, and the voyage being altered by order of his owners, the inſured ſhall be obliged, as ſoon as he receives knowledge thereof, to give notice to the underwriters, and agree with them concerning the altering of the premium, or leave the ſaid altering to the arbitration of the commiſſioners: otherwiſe the underwriters, in caſe of loſs, are not obliged to make it good, the inſured retaining his action only againſt the maſter, as receiver of the money.

20. A maſter being on his voyage, and receiving damage on the hull, or otherwiſe, and being obliged, for the repairing and reſtoring of his ſhip, in order to proceed on his voyage, to negotiate money on bottomry on his ſhip, the giver of the money ſhall be permitted to cauſe the amount of the ſaid bottomry, with the premium, to be inſured; although it ſhould happen to appear, that the owners, or ſome of them, had caused the ſhip, or his ſhare on the ſame to be inſured before or after.

21. Inſurances made on goods, which at the place of their lading, or any where elſe, are charged to the full with bottomry, are declared null and of no value, with forfeiture of the premium for the underwriter, and with the penalty of arbitrary correction. But the taker on bottomry, in caſe he ſhips more goods than the capital taken on bottomry doth amount

mount to, may cauſe that overplus alſo for the groſs average, to be inſured. The giver of the money, or the holder of the bottomry-bond, may alſo inſure his intereſt to the full, with the premium thereof, provided that in all the bills of lading, or manifeſts of the lading, the taking and receiving the bottomry money on the ſaid goods be particularly inſerted; with mention of the date, the place from whence, the perſon to whom paid, and for whoſe account. This is only to be underſtood of money given in this country, and from the American colonies, &c. to this country; but the inſurance being made from other places, the tenour of the bottomry-bonds muſt be obſerved.

But in caſe the orders for the inſurance was previouſly given by the lender, or it was already executed, the taker of the money ſhall be obliged to transfer, by aſſignment, the right to the ſaid policy or inſurance to the holder of the bottomry; and in default thereof the inſured ſhall not only be deprived of his demand on account of the ſaid policy, but his premium paid be kept by the underwriters.

Inſurance made on bottomry on goods is free of all groſs average, and diminution of value by their own waſte.

22. All goods, wares, and merchandiſes, none excepted, as alſo gold, ſilver, jewels, pearls, and precious ſtones, may be inſured to the full, with all charges till on board, the premium of inſurance included; and no valuation in the policy ſhall take place of goods and effects, whereof the real coſt or value can be produced; but goods of our own produce, and fabric, or thoſe obtained or accepted of by barter, and otherwiſe, under or above the current price, and whereof no proper invoice, with juſtification of intereſt, can be produced, may be valued in the policy with all charges till on board, and the premium of inſurance included; on neglect thereof the valuation ſhall be left to the inquiry and deciſion of the commiſſioners; and the inſurers may join in their plea.

23. If a perſon has made inſurance on goods which he doth not ſend or lade, or on goods which are not ſent to him, alſo if leſs in value is ſhipped than he has inſured, he may demand back the premium of inſurance of what is over-inſured, leaving one half *per cent.* to the inſurer: but if the goods are already laden from the key, or ſhore, in barks, wherries, or lighters, to be conveyed to the ſhips which were to tranſport them, and do return back, the abatement ſhall then be one *per cent.*

Returns of premium for inſurance on the hull of the ſhip

ſhall alſo take place if a ſtop is put to the voyage inſured; but one *per cent.* ſhall be paid to the inſurers for their trouble, and the riſk they have run. On the contrary, if, in caſe of loſs, or average, by exhibition of proofs, it be found that the ſum inſured doth amount to more than the value of the goods, the inſurers ſhall not be obliged to make good farther, or more, than the juſt value of the goods ſhipped; and being goods whereof no proper invoice and proof of intereſt can be ſhown, and which, therefore, according to Art. VII. and XXII. muſt be valued in the policy, the value they are ſet at, ſhall be obſerved; and what is more inſured, returned.

24. In returns, as alſo in averages and loſſes, the inſurers who have underwrote upon one and the ſame policy, although it be with the difference of dates, ſhall ſhare equally.

But if more than one policy is uſed and underwrote upon for one and the ſame parcel of goods and intereſt, then the firſt policy in date, without regarding the following policy, ſhall take place for the amount of the ſum inſured for the value of the goods and effects; and the reduction ſhall fall on the policy of later date, as well in caſe of returns, as of average and loſſes.

25. If an inſurer fails, it ſhall be lawful for the inſured to inſure anew again ſuch article of inſurance with another, on all good and bad tidings; and he may give notice, by the meſſenger of the chamber of inſurance, at the habitation of the failed inſurer, or to the aſſignee, and diſcontinue the riſk of the parcel underwrote by him.

26. If any kings, princes, potentates, or lords, ſhould arreſt, detain, or take in their countries any ſhip inſured, and it be uncertain whether the ſame will be recovered again or not, and alſo if ſhe ſhould become incapable to perform her deſtined voyage; then the owners and freighters, who have cauſed themſelves to be inſured, ſhall be obliged to retain for ſix months the property of the arreſted ſhips, and precious wares, be they alſo incumbered or not, before they may abandon their ſaid effects; commencing the ſaid ſix months from the time that they ſhall have given notice to the major part of the inſurers, who are on the ſpot, by the meſſenger of the chamber of inſurance, who ſhall give that notice; which ſix months ſhall be the time allowed, if the caſe ſhall have happened in Europe, and the bounds limited by the tenor of the XXIXth article. But if it ſhould happen

pen without thoſe limits, the inſured ſhall not abandon ſooner than till the expiration of twelve months, commencing with the day of the intimation; nevertheleſs the inſured ſhall not be hindered from taking ſome ſecurity in the meanwhile of the inſurers, by ſureties, pledges, or otherwiſe, according as the commiſſioners ſhall think proper: but the inſured notwithſtanding remain obliged, either by themſelves or by their correſpondent, to take care of the goods, and to promote as much as poſſible their diſcharge. They ſhall alſo be at liberty, within the ſaid limitation of time, to reſhip the ſame on board another ſhip, or ſhips; and the charges of fitting out, and of higher freight, alſo damage and waſte of the merchandiſes, occaſioned by the arreſts, ſhall be for account of the inſurers, in proportion to what they have underwrote.

27. But in relation to coarſe and periſhable wares, and merchandiſes, the inſured ſhall not be obliged to wait the aforeſaid time of ſix months within, and the twelve months without the limits, before they abandon; but may proceed with their concerns, according to circumſtances, and the condition of their goods: only they muſt beforehand give notice thereof, as above, to the major part of the inſurers.

28. When a ſhip inſured is become unnavigable, or the inſured ſhips, or other goods are ſtolen, taken by enemies, or otherwiſe ſpoiled, or loſt, or there are no hopes of recovering the ſame, the inſured may abandon all ſuch ſhips and goods for the benefit of the inſurers; and the ſame being duly done, the inſurers ſhall have three months after the intimation of the ſame to furniſh the payment of the ſum by them inſured.

29. In caſe any inſured ſhip or goods ſtays out a year and a day after it is inſured, and is departed from the port where ſhe was laden, without any thing having been heard of her in the mean while at the place of lading, or deſtined place of unlading, if it be in Europe, Barbary, the Canary iſlands, any part of the Mediterranean, the Levant, and Archipelago, or thereabouts, then the ſaid ſhip and goods ſhall be held to be loſt, and intimation thereof may be made to the inſurers, and payment demanded three months afterwards: and in regard to the place at a further diſtance, henceforth ſhall be obſerved at the ſpace of two years.

30. All actions for loſſes, or groſs averages on ſhips and goods, ſhall be brought, at the furtheſt, within the ſpace

of

of half a year after the diſaſters and damages have happened; if within the limits of Europe, as above, by Art. XXIX. is limited; but happening beyond theſe limits, the actions ſhall be brought within the ſpace of three years, and by law be proſecuted, and purſued, on pain of being non-ſuited.

31. The actions of loſſes, and groſs averages, which may happen on the goods mentioned in Art. IX. or ſuch like, going or coming by land, or over freſh water, ſhall be intimated to the inſurers, and be purſued, on pain of being non-ſuited, within half the ſpace of time enacted by Art. XXX.

32. In caſe the inſured ſhip or goods ſpoil of themſelves without any outward misfortune, the inſurer is not anſwerable for the ſame.

33. Whereas when people are inſured on the hull or body of a ſhip to the Weſt Indies, Guinea, Cape Verde, the Streights, or any other more diſtant places, out and home, it often happens that notwithſtanding ſhe had done with her trade, wholly or partly, and the returns or produce were ſent over with another ſhip or ſhips, to the great advantage of the inſured, the inſured nevertheleſs continue trading on: ſo that often, in length of time, the ſaid ſhip becomes unnavigable, or otherwiſe in danger; and alſo that ſhips being freighted by the month, have often carried their freights outwards, and have notably profited; but afterwards by being unnavigable, or by ſtorms happening to be loſt on this coaſt, or even in harbour, the inſurers are caſt to pay the ſaid ſhip what it was worth when it ſailed from this country, although the ſaid ſhip, if ſhe had made a ſafe voyage, was worth, or would have yielded by ſale, not above one third, or one half of what the inſurers pay; in ſuch caſes the commiſſioners are authoriſed to act and to diſpoſe as they, according to diſcretion, ſhall think proper

34. If any inſurance be made under the general denomination of goods and merchandiſes or whatever the intereſt of the inſured might conſiſt in, nothing excepted; and it be found that the riſk is run on wool, flax, hemp, ſtockfiſh, herrings, corn, round or flat ſeed, ſugars, peaſe, beans, cheeſe, books, and papers, the inſurers ſhall be free of damages under 10 *per cent.* and it is ſpecially forbidden to contract in the policy with a contrary clauſe.

But if inſurance be made by policy on any of thoſe wares and merchandiſes, expreſſing in the ſame that the riſk ſhall be

be run thereon, then the inſurer ſhall only be free of damage under 3 *per cent.*

35. The average or damage on goods that happened during the voyage by outward misfortune, ſhall be repartitioned on the groſs capital that the goods being ſound, would have amounted to at the place of their deſtination: on the other hand, it ſhall be lawful for the inladers, owners, or thoſe to whom they are conſigned, to make inſurance on the freight which they muſt pay for goods in caſe of a ſafe voyage; though on condition that the underwriters who have inſured thereon ſhall be obliged only to pay the eſtimate of the average fallen on the goods, and no more: and in caſe of a total loſs, returns can be demanded from him who has inſured on the freights.

36. The inſureds ſhall alſo be obliged to give notice to the inſurers of all the intelligence they receive of misfortunes, arreſts, or damages, befallen the ſhips or goods inſured, of which notice authentic copies, taken from the original letters, by the ſecretary and meſſenger of the chamber of inſurance, ſhall be communicated to the inſurers at their coſt, if they deſire it: on the contrary, the inſured ſhall be intitled to demand of the inſurers in proportion to what they have underwrote, ſuch ſums of money on account, for removing or retrieving of the misfortunes, damages, or arreſts, as it ſhall appear from the circumſtances of matters will be neceſſary.

And it being found that the inſureds were wanting or negligent in cauſing the ſaid notice to be given to the inſurers, they ſhall be obliged to refund them all the charges and damages with intereſt, occaſioned by this their neglect: and all this at the arbitration of the commiſſioners, as they, according to the circumſtances of matters, ſhall think proper.

37. All premiums of inſurance, either outwards or out and home jointly, whatever *per* hundred the ſame may amount to, ſhall be paid down at the underwriting of the policy.

The premium of inſurances that are made by the month, ſhall likewiſe be paid down for ſo many months as ſhall be ſtipulated in the policy; and for the further months to the end of the voyage, and the arrival of the ſhips at the deſtined place, on ſuch conditions as ſhall be agreed on.

But if the inſurer give credit for the premium to the broker, or others, he has his recourſe only on them; but if the broker or others become incapable, and the inſured have not paid

paid the premium to them, the inſured ſhall be obliged to pay the ſame to the inſurer.

38. And to prevent any fraud, all brokers and others who procure or ſolicit any inſurance, ſhall be obliged to make uſe of and employ no other policies but ſuch as are privileged and ſigned by the ſecretary: and they ſhall keep copies of all that is written in them by hand, on pain of loſing their earned ſalary, and four times as much, to and for the benefit of the poor; and ſuch penalty over and above as the gentlemen of the judicature ſhall think proper, according to the circumſtances of the caſe.

39. The brokers and others who procure any inſurance ſhall, for the conſideration of their brokerage, be obliged to exhibit in the chamber of inſurance, at all times when required, the copies kept by them, according to the foregoing article, that authentic copies thereof may be delivered for the uſe of the concerned, on pain to anſwer the default, if by their neglect of duly keeping the copies, any prejudice happen to be ſuffered.

The brokerage or commiſſion of inſurance, which, according to the practice for many years paſt, is paid only by the inſurers, ſhall be one quarter *per cent.* for each voyage; for which conſideration the brokers ſhall be obliged to anſwer for the premium.

The brokers or others ſhall alſo be admitted to ſummon their principals before the commiſſioners of inſurance concerning the premiums diſburſed, if payment be refuſed; and ſhall not be obliged to deliver the policy before, but to keep the ſame by them as a ſecurity.

The brokers, or others, who procure any inſurance, ſhall not be allowed to be inſurers themſelves.

40. It is farther enacted, that what is contained in this ordinance ſhall be underſtood of all inſurances which in this city ſhall be contracted and concluded, whether the inſured as well as the inſurers dwell in or without the city; whether the intereſt or riſk run for account of inhabitants or ſtrangers, friend or foes; all which in this regard ſhall be conſidered as having choſen their reſidence within the city: wherefore alſo all loſſes and averages ſhall be determined by the commiſſioners, according to the contents of this ordinance, except the groſs average has been judicially regulated beyond ſea at the ſhip's deſtined place.

41. And if ſomething ſhould be inſerted or agreed upon in the policy, that is not limited in the ordinance, ſuch conditions

ditions or ſtipulations ſhall be left to the deciſion of the commiſſioners.

42. And whereas the caſes from which groſs averages reſult, are ſo variable in circumſtances, that they cannot well be ſtipulated or provided for by any ordinance; thoſe matters are left to the commiſſioners, to be by them decided and regulated according to law, reaſon, and equity.

43. All differences ariſing between parties on account of inſurances made in this city ſhall preſently be examined, and by the commiſſioners of inſurance here be determined according to this ordinance: they alſo ſhall decide all differences proceeding from averages, as by the foregoing article.

44. And the commiſſioners may likewiſe decide according to the ſaid ordinance, all differences ariſing from inſurances made out of this city, which ſhall be relative to the chamber of inſurance, or to this exchange.

45. And the commiſſioners, jointly with the ſecretary, ſhall have of all the differences brought before them concerning loſſes, one third part of a guilder of each one hundred guilders for their labour and trouble; which money ſhall be diſburſed or paid by the plaintiff.

46. They ſhall likewiſe have one *per* thouſand of the capital for the ſettling of the groſs average, which the groſs average ſhall pay: as alſo of differences concerning premiums demanded, one *per* thouſand of the ſum inſured.

47. The loſs or damage of the ſhip or goods, having been made to appear to the commiſſioners by exhibition of policies, bills of ladings, manifeſts, proper certificates, or other juſt proofs, and the underwriting of the policies being alſo proved, and that intimation was made to the parties three months before of the loſs; the ſaid commiſſioners may order the money demanded, either the whole or part, to be proviſionally depoſited, with permiſſion to be inſured to receive the money depoſited, on giving ſufficient ſecurity to return the ſame, with intereſt at eight *per cent.* in caſe it is afterwards found that it ought ſo to be.

Provided always that copies of every thing, and a day to anſwer ſhall be granted to the reſpondent, on his requiring it, before the commiſſioners ſhall diſpoſe of the money proviſionally depoſited.

48. Any perſon being ſummoned concerning damage, and not appearing in three days to demand copies, or to deſire a day, he ſhall be proceeded againſt on the firſt, ſecond, and

third default; and on the third default the money depoſited ſhall be diſpoſed of either proviſionally, or finally, in ſuch manner as the commiſſioners think proper.

49. It ſhall be lawful to appeal from the decrees pronounced by the commiſſioners, as alſo from the regulation of groſs averages, to the magiſtrates (ſchepenen) of this city, within the ſpace of ten days: but from a proviſional decree there ſhall be no appeal.

50. All the inſurers ſhall alſo be obliged, when a repartition of damages ſhall have been made and iſſued forth by the commiſſioners of inſurance and average in this city, immediately to make good, and pay the ſaid damages; and in default thereof the inſurer ſhall be obliged to pay to the inſured intereſt at eight *per cent. per annum*, from the time that the ſaid repartitions ſhall be diſpatched, and iſſued forth, till the actual payment of the money, wherein the inſurers are caſt by the ſaid commiſſioners.

51. On the decrees of the commiſſioners execution ſhall alſo be made, as is daily practiſed on the decrees made by the worſhipful ſheriffs.

52. The proceedings in the aforeſaid chamber againſt the non-appearers, concerning damages demanded, ſhall be from three days to three days, for the firſt, ſecond, and a third default; and the parties being ſummoned, and not appearing, ſhall pay for the firſt time ſix ſtivers, for the ſecond time twelve ſtivers, and in caſe of the third default the regulation of Art. XVIII. ſhall be obſerved: and the coſts of ſuit for the defaults ſhall be diſburſed by the plaintiffs; but ſhall be charged to the non-appearer in the general account of the average.

53. The citations touching groſs averages ſhall be from eight days to eight days till the third citation incluſive, when the commiſſioners ſhall proceed to the valuation of their intereſt by the manifeſts, as they in equity ſhall think proper: and non-appearers ſhall not be permitted to appeal: and concerning the defaults, as in the foregoing article is enacted.

54. All merchants ſhall alſo be obliged to give up their goods according to the true value, (as is expreſſed in the bills of citation); and they ſhall be obliged, at the requiſition of the commiſſioners, to confirm their valuation by oath

55. And to the end that all premiums of inſurance for which the inſurers give credit to the brokers, and others, may be ſpeedily recovered, the commiſſioners are authoriſed

and

and qualified to proceed againſt them, after the firſt and ſecond demand made, *viz.* from day to day, and to grant execution after the ſecond demand.

56. And whereas the contracts of inſurance are judged to be contracts of good faith, wherein no fraud or deceit ought to take place; in caſe that it is found that the inſured or inſurers, captains, ſhippers, pilots or others, uſe fraud, deceit, or craft, they ſhall not only not profit with their ſaid deceit and craft, but ſhall alſo be liable to the loſs and damage with intereſt occaſioned by them, and be corporally puniſhed and corrected for a terrour and example to others; even with death, as pirates and manifeſt thieves, if it be found that they have uſed notorious malverſation or craft: the whole according to the edicts of the country.

57. If it ſhall appear to the commiſſioners, that any abuſe is committed by any perſon, in cauſing policies to be underwrote after having received notice that the ſhips, or goods, on which he cauſes inſurance to be made, are loſt, taken, or periſhed; and that on one policy firſt is cauſed to be underwrote a certain ſum on good faith, and afterwards a certain ſum on evil faith; in ſuch caſes the commiſſioners ſhall be obliged to refer the ſaid reſpective matters, and alſo the parties, to the worſhipful magiſtrates of this city, and further to cauſe the documents and proofs delivered by the parties, in their hands to be carried to the ſaid worſhipful magiſtrates.

58. For all inſurances and reinſurances to be made on ſundry ſhips, for whatſoever ſhare the ſame may be made, or on ſeveral goods laden in ſundry veſſels, a ſeparate and diſtinct policy ſhall henceforth be uſed, on pain that all other policies, in which ſhall be found more than one ſhip, or ſome ſhares in ſundry ſhips, or ſundry goods laden in ſeveral ſhips; to be inſured or reinſured, ſhall be held null, and of no value: and conſequently henceforth no decree on ſuch policies ſhall be given.

No book-printers, bookſellers, or other perſons in this city ſhall be permitted to print or ſell policies without ſtamps on penalty of three hundred guilders.

60. No inſurers, or inſured ſhall underwrite, or cauſe to be underwrote, but on policies furniſhed with a proper ſtamp, and ſigned by the ſecretary of the chamber of inſurance, who ſhall have three ſtivers for the ſame; on penalty of three hundred guilders over and above the penalty enacted by the ge-

neral edict and ordinance concerning the ſmall ſtamps, againſt the defrauders of the public revenue.

61. No brokers, or others, ſhall make any inſurance, or reinſurance, or cauſe the ſame to be done, or procured, but on policies ſtamped conformable to the ordinance, on penalty of one hundred guilders for the firſt time, one hundred guilders for the ſecond time, and ſuſpenſion for ſix weeks; and the third time they commit the ſame, two hundred guilders, and diſmiſſion from their office.

Variety XI. COMPUTATIONS IN EXCHANGE.

INTRODUCTION.

EXchange is the commutation of the money of one country for that of another, by means of a bill, inſtrument, or writ, commonly called *a bill of exchange*; the nature and form of which, with the laws, regulations, and cuſtoms concerning it, ſhall be particularly inſiſted on in the ſecond volume.

Exchange may likewiſe be defined, a fixing of the actual and momentary value of money. Silver, as a metal, hath a value like all other merchandiſes; but as it is capable of becoming the ſign of all other merchandiſes, or the medium by which they can be eſtimated, it may receive an additional value; for was it no more than a mere merchandiſe, its value would perhaps be leſs fluctuating, and of leſs conſideration than it is.—As money, the prince can fix a value upon ſilver in ſome caſes, and in others he cannot.——He can fix a proportion betwixt ſilver as a metal, and ſilver as money; betwixt the ſeveral metals made uſe of to paſs as money; he eſtabliſhes the weight and ſtandard of every piece of money, and aſſigns to it that ideal value, by which it is current. On the other hand, if we conſider the money of one country comparatively with that of another, it receives a new value, which is fixed by the current courſe of commerce, and the general opinion of merchants; but never by the laws of any particular nation, becauſe it is liable to inceſſant variations, and depends on the accidental circumſtances of trade, the money-tranſactions between nations, and the ſtate of their public credit. The ſeveral nations, in fixing this relative value, are chiefly guided by that particular nation which hath the greateſt quantity of ſpecie. If any one nation hath as much

ſpecie

ſpecie as ſeveral others together, it will then become neceſſary for theſe ſeveral nations to be regulated by the ſtandard of that one nation. In the actual ſtate of the univerſe, Holland, in this reſpect, ſeems to be the umpire, ſince ſhe regulates the exchange for almoſt all Europe, in a manner moſt agreeable to her own intereſt. This ſcarcity or plenty, from whence reſults the mutability of the courſe of exchange, is not real, but relative: for inſtance, when Glaſgow hath greater occaſion for funds in London, than London of having funds in Glaſgow, the price of bills muſt riſe at Glaſgow. The ſpecie of both cities is the ſame, both as to weight and ſtandard; and although there ſhould be money enough to purchaſe bills at Glaſgow upon London, yet when there is not a fund of credit at London equal to the debit, the price of bills, not of money, muſt riſe of courſe.

To ſet this ſubject in a more practical point of view, let us conſider.

1. That if our purchaſes and payments in foreign countries exactly balance their purchaſes and payments in ours, there will be juſt enough of bills on the one to clear accounts with the other; ſo that in this caſe the exchange on both ſides will be at par; that is, one who gives money in one country, will receive as much in the other in weight and ſtandard.

2. If a nation ſupplies us with more than it takes from us, or if we pay that nation more money than it pays to us, there will be a balance againſt us, which we muſt neceſſarily pay; in order to which, the demand for the money of that nation, or its bills of exchange, becomes greater among us than the quantity to ſupply that demand, which raiſes the value of their money or bills, and lowers ours, or, in other words, puts the price of their money above par, and ours below it, which conſtitutes what we call *the courſe of exchange*. From theſe two conſiderations we may naturally infer,

1. That the courſe of exchange betwixt two nations is a herald, which proclaims publicly the ſtate of commerce and money-negotiations betwixt them, and which of the two is indebted to the other.

2. That the nation which is indebted hath the diſadvantage in commerce and money-tranſactions, and that the one which hath the balance in its favour, hath in every reſpect the advantage.

3. That the balance of trade naturally imports ſpecie, and renders money at home more valuable abroad; whereas, on the other hand, when the balance is againſt a nation, their ſpecie is exported, and becomes thereby leſs valued.

That nothing may be wanting to render this treatiſe as complete as poſſible, I have thought proper to inſert Sir Iſaac Newton's table of the aſſays, weights, and values of moſt foreign ſilver and gold coins actually made at the mint, by order of the privy council, before the year 1717, with notes and explanations, and a calculation of the real or intrinſic par of exchange, as it ſtood 1719, when firſt publiſhed, and as it was republiſhed in London 1740.

TABLE

TABLE of FOREIGN SILVER COINS.

	Assay.	Weight		Stan. Wt.			Value.	
	dw.	dw.	gr.	dw.	gr.	mi.	d.	
The piaſter of Spain, or Seville piece of 8 reals, now reduced to 10	*W.* 1	17	12	17	10	2	54	
The new Seville piece of eight — — —	*W.* 1½	14		13	21	15	43	.11
The Mexico piece of eight — — —	*W.* 1	17	10	17	8	14	53	.83
The pillar piece of eight — — —	Sta.	17	9	17	9		53	.87
The Peru piece of eight, coarſer, but of uncertain allay —	*W.* 1	17	12	17	10	2	54	
The old ecu of France, or piece of 60 ſols Tournois ——	*W.* 1½	19	14½	19	11	12	60	.39
The new ecu, or piece of 5 livres, or 100 ſols —— —								
N. B. The ecu of France ſhould be 2 dwt worſe by law.								
The cruſado of Portugal, or ducat worth 400 reas, now marked and raiſed to 480 reas — — —	*W.* 2	11	4	11	1	13	34	.31
The patacks or patagons of Portugal, worth 500 reas, now marked and raiſed to 600 — — —								
The ducatoon of Flanders, or piece of 60 ſols or patars —	B. 4½	20	22	21	8	2	66	.15
The patagoon of Flanders, or croſs dollar, or piece of 48 patars	*W.* 12	18	1	17	1	13	52	.91
The ducatoon of Holland, or piece of 63 ſtivers —	B. 3	20	21	21	3	15	63	.59
The patagoon leg-dollar, or rix dollar of Holland, or piece of 50 ſtivers	*W.* 14	18		16	20	17	52	.28
The three guilder pieces of Holland, or piece of 60 ſtivers —	*W.* 2	20	8	20	3	12	62	.46
The guilder, florin, or piece of 20 ſtivers — —	*W.* 2	6	18½	6	17	1	20	.08
The ten ſchelling piece of Zeland, or piece of 60 ſtivers —	*W.* 2	20	6	20	1	13	62	.21
The lion dollar of Holland, or ⅓ of the ducatoon —	*W.* 44	17	14	14	2	7	43	.07
The ducatoon of Cologn — — —	B. 3	20	18	21	—	15	65	.02
The rix-dollar, or patagon of Cologn — —	*W.* 13	18		16	22	14	52	.53
The rix-dollar, or patagon of the Biſhop of Liege ——	*W.* 12	17	23½	16	22	5	55	.48

FOREIGN SILVER COINS.

	Affay.	Weight		Stan. Wt.			Value.	
	dw.	dw.	gr.	dw.	gr.	mi.	d.	
The rix-dollar of Mentz	*W.* 6	18	8	17	19	18	55	.27
The rix-dollar of Francfort	*W.* 9	18	8	17	14	4	54	.53
The rix-dollar of the Elector Palatine of the Rhine and Bavaria before 1620		18	5					
The rix-dollar of Nuremberg	*W.* 6	18	10	17	22	1	55	.55
The old rix dollar of Lunenburg	*W.* 10	18	11	17	15	2	54	.65
The old rix-dollar of Hanover	*W.* 8	18	12	17	20	2	55	.03
The double gulden of the Elector of Hanover	*W.* 7	18	18	18	3	16	56	.29
The gulden of the Elector of Hanover, or piece of $\frac{2}{3}$	B. $17\frac{1}{2}$	8	10	9	1	18	28	.14
The half-gulden of the electorate of Hanover, or piece of $\frac{1}{3}$	B. $17\frac{1}{2}$	4	5	4	12	19	14	.07
The gulden of the Duke of Zell, or piece of 16 guts groſh	*W.* 43	11	2	8	22	10	27	.07
The gulden of the Biſhop of Hildeſheim, or piece of 24 marien groſh, now raiſed to 26	*W.* $40\frac{1}{2}$	11	22	9	17	17	30	.21
The rix-dollar of Magdeburg	*W.* 10	18	12	17	16	1	54	.27
The gulden, or guilder of Magdeburg	*W.* 44	11	14	9	6		28	.67
The old rix-dollar of the Elector of Brandenburgh	*W.* 9	18	13	17	19	1	55	.17
The old gulden of Brandenburgh, now raiſed from 24 to 26 marien groſh	*W.* 43	12	4	9	19	9	30	.41
The gulden of Brandenburg, or piece of $\frac{2}{3}$	*W.* 43	11	3	8	23	6	27	.81
The half-gulden of Brandenburg, or piece of $\frac{1}{3}$	*W.* 43	5	13	4	11	14	13	.09
The gulden of the Elector of Saxony, or piece of $\frac{2}{3}$	*W.* 41	11	3	9	1	14	28	.12
The old bank dollar of Hamburg	*W.* 8	18	9	17	17	4	54	.92
The old rix dollar of Lubec	*W.* $8\frac{1}{2}$	18	16	17	22	17	55	.54

The four mark piece of Denmark, or coarſer alley —	*W.* 61	14	8	10	9	10	32	.23
The four mark piece of Denmark, for finer allay —	*W.* 21	11	13½	10	11	5	32	.45
The eight mark piece of Sweden — —	Stan.	20		20			64	
The four mark piece of Sweden — —	*W.* 58	13	12	9	23	7	30	.92
The two mark piece of Sweden — —	*W.*	6	19					
The old dollar of Dantzick — — —	*W.* 10½	18	9	17	12	14	54	.27
The old rix-dollar of Thorn near Dantzick —	*W.* 12	18	8½	17	8	15	53	.85
The rix-dollars of Sigiſmund III. and Vladiſlaus IV. Kings of Poland	*W.* 10	18	9	17	13	14	54	.04
The rix-dollar of the late Emperor Leopold — —	*W.* 10½	18	9	17	12	4	54	.27
The rix dollar of his predeceſſor Ferdinand III. — —	*W.* 10½	18	9	17	12	4	54	.27
The rix-dollar of Ferdinand Archduke of Auſtria —	*W.* 10½	18	5	17	8	7	53	.78
The rix-dollar of Baſil — — —	*W* 7½	18	18½	18	3	6	56	.24
The rix-dollar of Zune — — — —	*W.* 13	18	1	16	23	13	52	65
The old ducat of Venice, with the words *Ducatus Venetus* upon it; a piece of ſix old livres, afterwards raiſed, I think, to 6 livres 4 ſols de Picoli — — —	*W.* 23½	14	15	13	1	17	40	.50
The half ducat — — —	*W.* 23½	7	7½	6	12	18	20	.25
The new ducat, with the N° 124. upon it, ſignifying 124 ſols, or 6 livres 4 ſols de Picoli — — —		18	2					
The half thereof — — —		9	1					
The cruſado croiſat, or St. Mark of Venice, with the N° 140. upon it, ſignifying 140 ſols, or 7 livres de Picoli —		20	6					
The half cruſado, of the ſame form — —		10	3					
The quarter cruſado, of the ſame form — —		5	1					
Another coin of Venice — — —	*W.* 46	17	10	13	19	8	42	.08

FOREIGN SILVER COIN.

	Assay.	Weight		Stan. Wt.			Value.	
	dw.	dw.	gr.	dw.	gr.	mi.	d.	
The piece of two jewels	B. 6	3	15	3	17	7	11	.05
The ducat de banco of Nap. or piece of 5 tarins, or 10 carlins, or 100 gr.	W. 3	14	0½	13	1		40	.43
The half ducat	W. 3	7	0½	6	12	10	20	.21
The tarin, or fifth part of the ducat	W. 3	2	19½	2	14	12	8	.09
The carlin, or tenth part of the ducat	W. 3	1	9½	1	7	6	4	.04
The escudi escu, or crown of Rome, or piece of 10 Julios or 100 bayoches		20	14½					
The teſton of Rome, or piece of three Julios	W. 1	5	21½	5	20	17	18	.32
The ducat of Florence and Leghorn, or piece of 7 livres, or 10½ Julios	B. 8	20	3	20	20	6	64	.62
The Julio of Rome		2	5					
The piaſter ecu, or crown of Ferdinand II. Duke of Tuſcany	W. 1	17	12	17	10	2	54	
The piaſter ecu, or crown of Coſmus III. preſent Duke of Tuſcany, whoſe monies are about 4 *per cent.* lighter than thoſe of his father; this piece is 8½ Julios	W. 1	16	18	16	16	4	51	.69
The croiſat of Genoa, or piece of 7½ livres	B. 7	24	15	25	9	11	78	.74
The ecu d'argent of Genoa, or piece of 7 livres 12 ſols		17	21					
The piaſter ecu, or crown of Milan		20	20					
The Philip of Milan, a piece of 7 livres		3	22					
The livre, or 20 ſols piece of Savoy		1	23					
The ten ſols piece of Savoy	B. 16½	7	13	7	23	4	24	.07
A roupee	W. 75	12	19	8	11	5	26	.26
A gout gulden, or florin d'or, a Dutch coin of 28 ſtivers	W. 48	11	0	8	14	18	26	.72
Another gout gulden	W. 48	12	0	9	9	15	29	.15
Another								

GOLD COINS Unworn.

	Assay. car.	gr.	Weight. dw.	gr.	Stan. Wt. dw.	gr.	mi.	Value. s.	d.	
The old Louis d'or	*W.* 0	$0\frac{1}{2}$	4	8	4	7	8	16	9	.3
The half and quarter in proportion	*W.* 0	$0\frac{1}{2}$	2	4	2	3	14	8	5	
The new Louis d'or	*W.* 0	$1\frac{1}{2}$	5	$5\frac{3}{7}$	5	3	18	20	0	.6
The half and quarter in proportion	*W.* 0	$1\frac{1}{2}$	2	$14\frac{7}{01}$	2	13	19	10	0	.3
The old Spaniſh double doubloon.	*W.* 0	$0\frac{1}{2}$	17	8	17	5	12	67	1	.4
The old Spaniſh double piſtole	*W.* 0	$0\frac{1}{2}$	8	16	8	14	16	33	6	.7
The old Spaniſh piſtole	*W.* 0	$0\frac{1}{2}$	4	8	4	7	8	16	9	.3
The new Seville double piſtole	*W.* 0	3	8	$16\frac{1}{3}$						
The new Seville piſtole			4	$18\frac{1}{6}$						
The half and quarter in proportion	*W.* 0	$0\frac{1}{4}$	6	22	6	21	12	26	10	.4
The doppia moeda or double moeda of Portugal, new coined.	*W.* 0	$0\frac{1}{4}$	6	$21\frac{3}{4}$	6	21	7	26	9	.9
The doppia moeda as they come into England.	*W.* 0	$0\frac{1}{4}$	3	11	3	10	16	13	5	.1
The moeda of Portugal	*W.* 0	$0\frac{1}{4}$	1	$17\frac{1}{2}$	1	17	8	6	8	.5
The half-moeda	B. 1	2	2	$5\frac{3}{7}$	2	9	7	9	3	.6
The Hungary ducat	B. 1	2	2	$5\frac{1}{2}$	2	9	3	9	3	.2
The ducat of Holland coined *ad legem imperii*	B. 1	2	2	$5\frac{1}{2}$	2	9	3	9	3	.2
The ducat of Campen in Holland.	B. 1	2	2	$5\frac{1}{2}$	2	9	3	9	3	.2
The ducat of the Biſhop of Banberg	B. 1	2	2	$5\frac{1}{2}$	2	9	3	9	3	.2
The double ducat of the Duke of Hanover.	B. 1	2	4	$10\frac{1}{2}$	4	17	9	18	4	.8
The ducat of the Duke of Hanover	B. 1	2	2	$5\frac{1}{2}$	2	8	10	9	2	.7
The ducat of Brandenburg.	B. 1	2	2	$5\frac{1}{2}$	2	9	3	9	3	.2
The ducat of Sweden	B. 1	2	2	$5\frac{1}{2}$	2	9	3	9	3	.2
The ducat of Denmark	B. 1	2	2	$5\frac{1}{2}$	2	9	3	9	3	.2

GOLD COINS Unworn.

	Affay. car.	gr.	Weight. dw.	gr.	Stan. Wt. dw.	gr.	mi.	Value. s.	d.	
The ducat of Poland	B. 1	2	2	5	2	8	12	9	2	.1
The ducat of Tranſylvania	B. 1	1½	2	4¾	2	7	6	8	11	.6
The ſequin, chequin, or zacheen of Venice	B. 1	3½	2	5¾	2	10	7	9	5	.7
The old Italian piſtole	*W.* 0	0½	4	6¾	4	6	11	16	7	.6
The double piſtole of Pope Urban, 1634			8	14½						
The half-piſtole of Innocent II. 1685			2	4						
A double piſtole of Placentia			8	10						
A double piſtole of Genoa, 1621			8	16						
A double piſtole of Milan			8	13½						
A ſingle piſtole of Milan			4	6¾						
A piſtole of Savoy, 1665			4	8½						
Double ducats of Caſtile, Genoa, Portugal, Florence, Hungary, and Venice	B. 1	2½	4	11	4	18	18	18	7	.7
Single ducats of the ſame places	B. 1	2½	2	5½	2	9	9	9	3	.8
Double ducats of the ſeveral forms in Germany	B. 1	1	4	11	4	17	1	18	4	
Single ducats of the ſame places	B. 1	1	2	5½	2	8	5½	9	2	
Double ducats of Genoa	B. 1	2	4	11	4	18	6	18	6	.5
Single ducats of Genoa, Benſançon, and Zurich	B. 1	2	2	5½	2	9	3	9	3	.2
Piſtole of Rome, Milan, Venice, Florence, Savoy, Genoa, Orange, Trevon, and Benſançon	*W.* 0	0¼	6	6	4	5	17	16	6	.7
A Barbary ducat, with Arabic letters on both ſides, in ſquare tablets, without any effigies or eſcutcheon	*W.* 2	1¼	2	16¼	2	9	6	9	3	.5

N.B. The gold coin having been valued when guineas were at 21*s.* 6*d.* they are here reduced to the preſent ſtandard of 21*s.*

For underſtanding the foregoing table, it is to be obſerved, that the Engliſh pound Troy contains 12 ounces; 1 ounce, 20 pennyweights,; 1 pennyweight, 24 grains; and 1 grain, 20 mites.

The preſent Engliſh ſtandard for gold coin is 22 carats of fine gold, and two carats or $\frac{1}{11}$ of alloy.

The ſilver coin contains 11 ounces 2 pennyweight fine ſilver, and 18 pennyweight of alloy in the pound.

The firſt column of the table expreſſeth the fineneſs of the aſſayed piece, the letter B. ſignifying *better*, and *W. worſe* than the Engliſh ſtandard.

The ſecond column the abſolute weight of the piece.

The third column its ſtandard weight, or its quantity of ſtandard metal.

The fourth column its value in Engliſh money.

Art. I. EXCHANGE with IRELAND.

In Ireland accounts are kept in pounds, ſhillings, and pence Iriſh, divided as in Britain; but having no coins of their own, they are ſupplied by the different countries with which they have commerce. Britain exchanges with Ireland upon the *L.* 100 *Sterling*, the par of which in Iriſh money is *L.* 108, 6*s.* 8*d.*; ſo that the ſhilling Sterling, according to that equation, will be worth 13 pence Iriſh. The courſe of exchange runs from 5 to 12 *per cent.* according as the balance of trade is in favour of Ireland, or againſt it.

Caſe 1. When Iriſh money is required; let *L.* 100 be the firſt term, its equivalent Iriſh according to the courſe, the ſecond term, and the given Sterling the third; then will the fourth proportional be the Iriſh money required.

Caſe 2. If Sterling is required; let the courſe of exchange equivalent to *L.* 100 be the firſt term, *L.* 100 the ſecond, the given Iriſh the third; then will the fourth proportional be the anſwer.

Examples of Iriſh exchanges.

Exam. 1. Glaſgow remits to Ireland *L.* 357, 18*s. Sterling*; for how much Iriſh ought Glaſgow to be credited for this remittance, when the exchange is at 10$\frac{1}{2}$ *per cent.*

Sterl.

Sterl. *Irish.*
L. 100 : $110\frac{5}{8}$ :: 357.9
$110\frac{5}{8}$

39369.0
178.95 = $\frac{4}{8}$ or $\frac{1}{2}$ of 357.9
44.7375 = $\frac{1}{8}$ or $\frac{1}{4}$ of $\frac{1}{2}$

Irish *L.* 395.926875 = *L.* 395-18-$6\frac{9}{20}$ *Ans.*

The same answer can very readily be effected by practice, thus.

357.9
35.79 = $\frac{1}{10}$ for 10 *per cent.*
1.7895 = $\frac{1}{20}$ of $\frac{1}{10}$ for $\frac{4}{8}$ or $\frac{1}{2}$
.447375 = $\frac{1}{4}$ of $\frac{1}{20}$ of $\frac{1}{10}$ for $\frac{1}{8}$

395.926875 as before.

Exam. 2. Ireland draws on Glasgow for *L.* 395-18-$6\frac{9}{20}$ Irish, exchange at $10\frac{5}{8}$ *per cent.*; how much Sterling will Ireland be debited with at Glasgow when this bill is discharged?

$110\frac{5}{8}$: 100 :: 395.926875
8 160
5)885 5)800 177)63348.300000(357.9 as given in the (first example.
177 160 531
1024
885
1398
1239
1593
1593
(0)

Art. II. Exchange with America and the West-Indies.

In America and the West-Indies, as in other parts of the British dominions, accounts are kept in pounds, shillings, and pence, divided as in Britain, and their money, for distinction's

tion's ſake, is called *currency*. Upon the continent payments are ſeldom made in ſpecie, as there are few coins circulating among them, but ſome French and Spaniſh pieces, the value of which, by a ſtatute in the ſixth year of Queen Anne, was aſcertained as follows.

	Weight.		*true value.*		*cur. value.*	
	dwt	*gr.*	*s.*	*d.*	*s*	*d.*
Dollar old plate of Seville	17	12	4	6	6	0
Ditto of new - -	14	—	3	$7\frac{1}{2}$	4	$9\frac{5}{6}$
Mexico ditto - - -	17	12	4	6	6	0
Pillar ditto - - - -	17	12	4	$6\frac{1}{4}$	6	0
Peru ditto old plate - -	17	12	4	5	5	$10\frac{5}{6}$
Croſs dollar - - -	18	—	4	$4\frac{1}{2}$	4	$10\frac{5}{6}$
Ducatoon of Flanders - -	20	21	5	6	7	4
French old crown - -	17	12	4	6	6	0
Cruſado of Portugal - -	11	4	2	$10\frac{1}{4}$	3	$9\frac{5}{6}$
Three guilder piece of Holland	20	7	5	$2\frac{1}{4}$	6	$10\frac{11}{12}$
Old rix-dollar of the empire	18	10	4	6	6	0

The ſcarcity of ſpecie obliges them to ſubſtitute a paper-currency for carrying on their trade, which being ſubject to innumerable caſualties, ſuffers generally a very great diſcount for Sterling in the purchaſe of bills of exchange, or good ſilver or gold. This is not the caſe however with the Weſt Indies; for their intercourſe with the Spaniſh ſettlements furniſhes them with ſuch an abundance of ſpecie, that at an average the exchange may be reckoned at 7 currency to 5 Sterling.

The method of computing the exchanges is in this caſe the ſame as with Ireland, and therefore the rule needs not be repeated.

Examples of the exchanges with America, &c.

Exam. 1. Glaſgow receives an account of ſales from Philadelphia, the nett proceeds amounting to 575 *l.* 19 *s* 6 *d.* currency; for how much Sterling may Glaſgow debit Philadelphia, the exchange being at 80 *per cent.*?

180 : 100

Cancel the ciphers, and divide by 2. 9 : 5 :: 575 19 6

5

9) 2879 17. 6

319 19 $8\frac{2}{3}$ *Anſwer.*

Exam.

Exam. 2. Glaſgow receives a bill of exchange from Philadelphia for 319 *l.* 19 *s.* $8\frac{3}{7}$ *d.*; for how much currency is Glaſgow debited at Philadelphia, the exchange being at 80 *per cent.*?

By cancelling and dividing as above.

100 : 180
5 : 9 :: 319 19 $8\frac{3}{7}$
9

5) 2879 17 6

575 19 6 currency. *Anſ.*

Exam. 3. Philadelphia is indebted to Glaſgow in 1575 *l.* 14 *s.* 9 *d.* currency; what Sterling may Glaſgow reckon on to be remitted when the exchange is at 75 *per cent.*?

First, 175 : 100 :: 1575 14 9, the two firſt terms of which (being abbreviated.

By dividing them by 5×5, there will be this new ſtate

Cur. *Ster.* *Cur.*
7 : 4 :: 1575 14 9
4

7) 6302 19

900 8 $5\frac{1}{7}$ *Sterling.* *Anſwer.*

Exam. 4. Glaſgow receives a bill of exchange from Philadelphia for 900 *l.* 8 *s.* $5\frac{1}{7}$ *d.* *Sterling*; for how much currency was Glaſgow debited, the exchange being at 75 *per cent.*?

The firſt and ſecond terms being abbrev. as above, it will be

Ster. *Cur.* *Ster.*
4 : 7 :: 900 8 $5\frac{1}{7}$
7

4) 6302 19

1575 14 9 currency, *Anſwer.*

Or by practice thus, *L.* 900 8 $5\frac{1}{7}$ for 100
450 4 $2\frac{4}{7}$ for 50 being $\frac{100}{2}$
225 2 $1\frac{3}{7}$ for 25 being $\frac{50}{2}$

1575 14 9 cur. 175

Exam. 5. Glaſgow conſigns to Virginia goods *per* invoice amounting to 578 *l.* 19 *s.* 6 *d.* which are ſold for 847 *l.* 15 *s.* 6 *d.* currency; what Sterling ought the factor to remit, deducting 5 *per cent.* in full of commiſſion and charges, and what doth Glaſgow gain *per cent.* upon the adventure, ſuppoſing the exchange at 30 *per cent.*?

Exch. Com.

130 + 5 = 135 : 100
27 : 20 :: 847.775
20

3) 16955.500

9) 5651.83

627.981 to be remitted,
578.975 conſigned.

49.006 gained on the whole.

Then 578.975 : 49.006 :: 100
100

578.975) 4900.600 (8$\frac{1}{2}$ neareſt.
4631.800

268.800

Exam. 6. Virginia is indebted to Glaſgow in 575 *l.* 19 *s.* 6 *d.* *Sterling*; with how much currency will Glaſgow be credited at Virginia, when the exchange is at 33$\frac{1}{3}$ *per cent.*?

Firſt 100 : 133$\frac{1}{3}$
3 3

300 : 400 both terms reduced to thirds.

By cancelling the ciphers, it will be 3 : 4 :: 575 19 6
4

Or practically,
575 19 6 for *L.* 100
191 19 10 for 33$\frac{1}{3}$

L. 767 19 4 *Anſwer.*

3) 2303 18 0

767 19 4 curr^{y}.

Or thus, *L.* 575 19 6 for 100
191 19 10 for $33\frac{1}{3}$ or $\frac{100}{3}$
$133\frac{1}{3}$
767 19 4 currency. *Anſwer.*

Exam. 7. Glaſgow is indebted to Carolina in 5759*l.* 18 s. 9 *d.* currency, exchange at 550 *per cent.*; for how much Sterling may Carolina value on Glaſgow?

Firſt 550 : 100. Cancel one cipher on each ſide, and divide by 5, then it will ſtand thus,

11 : 2 :: 5759 18 9
2
11) 11519 17 6
1047 5 $2\frac{8}{11}$ *Sterling.* *Anſwer.*

Exam. 8. Jamaica is indebted to Glaſgow in *L.* 1550 currency, for which Glaſgow is ordered to draw on London, exchange 40 *per cent.*; how much money does Glaſgow draw for the bill, being allowed 1 exchange for the draught to London?

7 : 5 :: 1550
5
7) 7750
100) 1107 2 $10\frac{1}{4}$ value of the bill.
2) 11 1 $4\frac{1}{2}$ at 1 *per cent.* exchange.
5 10 $8\frac{1}{4}$ at $\frac{1}{2}$ *per cent.*
1123 14 11 received at Glaſgow.

OBSERVATION.

When Britain exchanges upon the *L.* 100, as in the above inſtances, the higher the exchange is, the advantage to Britain in remitting is the greater, and in drawing the leſs. Suppoſe, for inſtance, that the exchange betwixt Britain and Ireland is at 12 *per cent.* I can in that caſe purchaſe a bill for *L.* 100 *Sterling* to diſcharge a debt of *L.* 112 Iriſh, whereas had the exchange been at 5 *per cent.* the ſame bill would have coſt me *L.* 106 : 13 : 4 *Sterling*; but what I gain by remitting on this occaſion is loſt by the drawer of the bill; for his credit

credit in Ireland is leſſened by *L.* 112 Iriſh, and he hath only received *L.* 100 *Sterling*, whereas had the exchange been at 5 *per cent.* he would have received *L.* 106 : 13 : 4 *Sterling*, for his 112 Iriſh. They who deal in exchange with Ireland, ought to be well informed at all times of the ſtate of trade betwixt the two nations, and on whoſe ſide the balance lies; for as the riſe and fall of exchange is the true barometer of the balance of trade, ſo likewiſe by having a proper intelligence of the imports from Ireland, and exports thither, one may in a great meaſure diſcern what will be the ſtate of the exchange. Suppoſe, for example, Ireland had imported from Britain goods to the amount of *L.* 20,000, and had exported thither to the value of but *L.* 10,000, it is plain that Ireland can be at par with Britain for no more than *L.* 10,000; and yet there is a balance of *L.* 10,000 ſtill due, which muſt be remitted to Britain before the account is evened. When there is no money due in Britain to compenſate this balance, Sterling money in Ireland will become dear, and Iriſh money cheap, and as the demand for bills increaſes, the price will be proportionally raiſed. The Iriſh merchant who foreſees this, will lay in a fund of credit in Britain for the occaſion; and though at this time he can receive *L.* 112 Iriſh for his draught of *L.* 100, he may be able, by the time his bills fall due, to purchaſe remittances at *L.* 105. The Britiſh merchant, on the other hand, will muſter up all he can to purchaſe remittances, to raiſe a ſtock of Iriſh money, which, upon the turn of the balance he can draw for, with the odds of 5 or 6 *per cent*, perhaps, in his favour.

When the exchange with the plantations in America is high, which is generally the caſe where there is not a ſufficiency of produce fit for the Britiſh market to anſwer the imports from Britain, bills of exchange are often a very expenſive remittance; for which reaſon thoſe who have ſtores abroad, and can afford to lie a little out of their money, chuſe rather to purchaſe ſuch produce as will come to the quickeſt market in ſome other colony upon the continent, or in the Weſt Indies, in order to be remitted from thence in produce or in bills of exchange.

Examples of exchange applied to drawing and remitting.

Exam. 1. When the exchange was at 12 *per cent.* Britain remitted to Ireland *L.* 5000; for how much Sterling ought Britain to draw for a reimburſement when the exchange falls to 6 *per cent.*?

First, 100 : 112 :: 5000
112

100) 60000

5600 amount in Ireland at 12 *per cent.*

2dly, 106 : 100 :: 5600
100

106) 560000 (5283 0 4$\frac{1}{2}$ *Sterling. Answer.*
530

300
212

880
848

320
318

2
20

40
12

480
424

56

Or more expeditiously as barter.

Ir. *Ster.* *Ir.*
112 : 5000 :: 106
112

106) 560000

L. 5283 0 4$\frac{1}{2}$ as before.

Hence Britain gains by this transaction *L.* 283 : 0 : 4$\frac{1}{2}$ which will be found to be above 5 *per cent.*

Exam.

Exam. 2. When the exchange with Ireland roſe to 12 *per cent*. Ireland drew on London for *L.* 5000 *Sterling*; how much Iriſh muſt be remitted to London to diſcharge the debt when the exchange falls to 6 *per cent.*?

Firſt,	5000	at 100	*per cent.*
	500	at 10	*per cent.*
	100	at 2	*per cent.*
	5600	at 112	Iriſh received for draughts.
2dly,	5000	at 100	*per cent.*
	250	at 5	*per cent.*
	50	at 1	*per cent.*
	5300	at 106	Iriſh remitted.

Difference 300 gained by Ireland, which is 6 *per cent.*

Art. III. EXCHANGE with HOLLAND.

INTRODUCTION.

In Holland there are two banks, the one of Amſterdam, and the other of Rotterdam. That of Amſterdam is not only the more famous of the two, but the moſt conſiderable in Europe. It was eſtabliſhed on the 31ſt of January 1609, by the authority of the States General, under the direction of the burgomaſters of the city, who having conſtituted themſelves the perpetual caſhiers of the merchants of Amſterdam, are themſelves a ſecurity for the bank; and as buſineſs in the bank is negociated by transfers, millions may be paid in a day without the intervention of any caſh, which is of the greateſt conſequence in expediting trade that can poſſibly be imagined. Authors differ about the real ſum of money that is depoſited in this bank, but few have reckoned it under 30 millions Sterling.

It is to this bank the city of Amſterdam owes its ſplendour and magnificence, which, though it poſſeſſes the greateſt part of the merchants ready money, rather promotes than interrupts their commerce, by the ſecurity and diſpatch with which a bank-credit is attended.

By the eſtabliſhment of this bank it is ordained, that bills of exchange, and the payment of wholeſale goods, ſhall only be in bank, unleſs the ſum be under 300 guilders; in which

caſe it cannot be entered into bank without a duty of 6 ſtivers, excepting by the Eaſt and Weſt India companies, who can enter into bank what ſums they pleaſe without any duty whatever.

To have an account opened in the bank, there is a duty impoſed of 10 guilders for once only; but if at any time that account ſhould be overdrawn, the merchant incurs a penalty of 3 *per cent.*

A merchant may draw his caſh out of the bank at any time upon allowing $\frac{1}{16}$ *per cent.* for bank-ſecurity; but if at that time the agio, that is, the difference betwixt the bank and current money, or the diſcount to which the current money is liable, be below 5 *per cent.* the treaſurer is obliged to make good the difference, as 5 *per cent.* which ſeems to have been the original agio, is always charged when it is received.

No merchant can draw for the money he puts into bank, or any part of it, until the next day, without making an allowance of $\frac{1}{4}$ *per cent.* unleſs the bank had been opened only the day before, after balancing the books, or at the feaſt of Pentecoſt.

All accounts with the bank muſt be balanced twice a-year, and that within ſix weeks after the bank is opened, under the penalty of 15 guilders.

No procuration is good at the bank unleſs it be regiſtered there, and the noting of ſuch procuration coſts 50 ſtivers.

The time of noting in the bank is from ſeven to eleven in the forenoon; after which to three in the afternoon every note carried in will coſt 6 ſtivers, and after three none are admitted.

When money is depoſited in the bank, the depoſitor may call for it in ſpecie, when he wants it, upon allowing a premium ſeldom exceeding $\frac{1}{4}$ *per cent.* for bank-ſecurity.

No money can be given in loan but upon ſecurity that is unexceptionable, and in judging of ſuch ſecurity the directors muſt be unanimous.

No director can uſe the freedom to abſtract any money from the bank to ſupply any private demand, though but for a ſingle day, upon pain of death.

The ſtrictneſs and fidelity with which this famous bank is kept, is productive of ſo great a ſecurity on the part of the citizens, and contributes ſo much to diſpatch in money matters, when a large ſum can be negotiated with a ſingle debit and a credit, that a bank payment is reckoned from 3 to 6 *per cent.* better than a payment in caſh, beſides a premium allowed

lowed the bank for every depoſit. It is no wonder then if this bank be immenſely rich, ſince the inſtitution is ſo judicious, the regulations ſo wiſe, and the direction ſo proper

In Holland they keep their accounts in pounds, ſhillings, and pence Flemiſh, divided as the Britiſh pound, but more generally in guilders or florins, ſtivers, and phinnings, reckoning 16 phinnings to a ſtiver, and 20 ſtivers to a guilder or florin.

They reckon likewiſe 6 guilders or florins to the pound Flemiſh.

Britain exchanges with Holland upon the pound Sterling, for which the latter gives an uncertain number of ſhillings and pence, or grotes Flemiſh, according to the courſe of exchange, which runs from 30 to 40 *s.* Flemiſh *per* 20 *s.* Sterling. The par of a pound Sterling, according to Sir Iſaac Newton's table, will be found to be *L.* 1 : 16 : 6 Flemiſh; but a guinea paſſes in Holland for 12 guilders according to which eſtimation their coins may be reckoned as follows.

A duke - - -	*L.* 0	0	$0\frac{21}{176}$
A ſtiver - - -	0	0	$1\frac{1}{20}$
A ſchilling - - -	0	0	$6\frac{3}{10}$
A guilder - - -	0	1	9
A Zealand dollar - -	0	2	$7\frac{1}{2}$
A rix-dollar - -	0	4	$4\frac{1}{2}$
A dry guilder - -	0	5	3
A ducat - - -	0	9	$2\frac{1}{2}$

To compute the exchanges with Holland, or any other place, where it is made upon the pound Sterling.

Caſe 1. If Dutch money is required, let *L.* 1 *Sterling* be the firſt term, its equivalent Dutch the ſecond, and the Sterling to be exchanged the third; then will the Dutch money required be the fourth proportional. The equivalent Dutch money will likewiſe be found very readily by practice.

Caſe 2. If Sterling is required, let the Dutch money equivalent to *L.* 1 *Sterling* be the firſt term, *L.* 1 the ſecond, and the given Dutch the third, then will the Sterling required be the fourth proportional.

Examples of exchanges with Holland.

Exam. 1. London is indebted to Holland in L. 270 : 8 : 2 *Sterling*, with how much Flemiſh is London debited at Amſterdam, when the exchange is at 35*s.* 6*d.* *Flem. per* pound Sterl.?

L.

L. St. L. Fl.

1 : 1.775 :: 270.40833

1.775

135204166
189285833
189285833333
270408333333

479.974791 66 = *L.* 479-19-5$\frac{11}{20}$ Flemiſh.

By practice thus:

				L.	*Flem.*	
270	8	2	for	1	0	0
135	4	1	for	0	10	0
67	12	0$\frac{1}{2}$	for	0	5	0
6	15	2$\frac{1}{10}$	for	0	0	6
479	19	5$\frac{11}{20}$	as before.			

Exam. 2. Holland is indebted to London in nett proceeds of tobacco, booked there at 479 *l.* 19 *s.* 6 *d.* Flemiſh; for how much Sterling may London draw, the exchange being at 35 *s.* 6 *d.* Flemiſh *per* pound Sterling?

L. Flem. *L. St.* 5) *L. Flem.*

5) 1.775 : 1 :: 479.975

5) .355 5) 95.995

.071 .071) 19.199 (270-8-2 *Sterling.* *Anſwer.*

142

499
407

29
20

580
568

12
12

144
142

(2) *Exam.*

Exam. 3. Amſterdam remits to London 5104 guilders, 8 ſtivers, and 2 pennicks, exchange at 35 *s.* 6½ *d.* Flem. banc. what will this remittance credit Amſterdam for at London?

Firſt, find the guilders contained in the exchange, by proportioning, as 20 is to 6, thus:

$^2|20 : {}^2|6 :: 35.5416 : 10.6625$
$10 : 3$

Hence to multiply by .3, being the ſame as to multiply by 3 and divide by 10, .3 will be a common multiplier; the product of which into the courſe of exchange will always give the guilders contained in a pound Sterling: wherefore,

35.5416
.3

10.66250 guilders=*L.* 1 at 35 *s.* 6½ *d.* Flem. exch.

Then 10.6625 : 1 :: 5104.40625

2.1325	1020.88125
.4265	204.17625
.0853	)40.83525(478.725=*L.* 478-14-6
	3412
	6715
	5971
	7442
	6824
	6185
	5971
	2140
	1706
	4340
	4265
	(75)

Or thus, 35 $6\frac{1}{2}$ — 12 — 5) 426.5 — 85.3

5104 8 2 — 40 — 5)204176.25 — 40835.25 (478.725=*L.* 478·14·6

3412

6715
5971

7442
0824

6185
5971

2140
1706

4340
4265

(75)

In multiplying by 40 the number of grotes in a guilder, 16 grotes are taken in for 8 ſtivers, and .25 is the 2 phennings expreſſed in the decimal of a grote.

Exam. 4. London is indebted to Amſterdam in *L.* 478, 14 *s.* 6 *d. Sterling*, for how many guilders may Amſterdam draw, the exchange being at 35 *s.* $6\frac{1}{2}$ *d. per* pound Sterling.

478.725
35 ſchillings.

2393625 } at 35
1436175 }
239362 at 6
19946875 at $\frac{1}{2}$

17014·684375 ſchillings.
·3

5104.4053125 guilders.

Or,

478.725	for	*L.* 1
239.3625	for	— 10
119.68125	for	— 5
11.968125	for	— — 6
.997344	for	— — $\frac{1}{2}$

850.734219 *L.* Flemiſh.
6

5104.405314 guilders.

Exam. 5. A merchant in Glaſgow is credited at Amſterdam for 2154 guilders, 12 ſtivers, and 4 pennicks, current money; for how much Sterling may Glaſgow value on Amſterdam, exchange 35 *s.* $3\frac{1}{2}$ *d.* Flem. banc. agio $4\frac{1}{2}$ *per cent.*? Firſt,

	C.		B.		C		B.
First,	104.5	:	100	::	2154.6125	:	2061.83

2dly, 35 $3\frac{1}{2}$ 2061.83
12 40

423.5) 82473.20

194.742 *Answer*, = L. 194-14-10

Exam. 6. Glasgow draws on Amsterdam for *L.* 194:14:10 *Sterling*, exchange at 35 *s.* $3\frac{1}{2}$ *d.* Flem. banc. *per* pound *Sterling*; how much current money will pay the draught, agio at $4\frac{1}{2}$ *per cent.?*

First, 194.742	for 20	Then $^{s\,o}$|2061.83	
97.371	for 10	41.236	for 2 *per cent.*
48.6855	for 5	41.236	for 2
2.434275	for 0 6	10.309	for $\frac{1}{2}$
.4057125	for 0 $0\frac{1}{2}$		
		2154.613	cur. guilders.

343.6384875 Flem. pounds.
6

2061.830925 guilders banco.

Exam. 7. When the exchange is at 35 *s.* what is the price of the guilder.

35
12

2) 420 *d. Flem.* : *d. St.* 240 :: *d. Flem. in a guilder.* 40
12

3) 21
4
7
40

7)160

$22\frac{6}{7}$ *d. Sterl. Answer.*

Exam. 8. When the guilder is sold at $22\frac{6}{7}$ *d. Sterling*, what is the exchange betwixt Britain and Holland?

$22\frac{6}{7} : 40 :: 240$ *Sterl.*

1 7

4) 160 4) 1680

4 12) 420

35 *Answer.*

Exam. 9. When the bank-guilder is worth 22 *d. Sterling*, what ought to be the price of the current guilder, agio 4 *per cent.*?

104 : 100 :: 22

100

104) 2200

$21\frac{3}{13}$ *d. Answer.*

Holland exchanges with the trading nations upon the continent as follows:

With France upon the French crown, for 54 grotes, more or leſs
With Hamburg, upon the dollar, for 32 Flemiſh ſchillings, more or leſs,
With Spain, upon the ducat of 375 marvadies, for 97 grotes, more or leſs,
With Portugal, upon the cruſado of 400 reas, for 44 grotes, more or leſs,
With Genoa, upon the piaſtre of 5 liv. banco, for 92 grotes, more or leſs,
With Venice, upon the ducat of 24 gros banco, for 88 grotes, more or leſs,
With Leghorn, upon the piaſtre of 20 ſols d'or, for 86 grotes, more or leſs,
With Geneva, upon the crown of 60 ſols curt. for 90 grotes, more or leſs,

} according to the courſe.

And the computation is the ſame with the exchanges betwixt Britain and the ſame places.

Art. IV. Exchange with the Auſtrian Netherlands.

Antwerp was once the metropolis for trade of the whole Seventeen Provinces, although Amſterdam and Rotterdam are at this day by far its ſuperiours. It is however the principal place of exchange in the Auſtrian Netherlands, and ſtill hath a conſiderable trade. The par of a pound Sterling at Antwerp, according to Sir Iſaac Newton, is 34 *s.* 11 *d.* Flemiſh; but later authors make it different; ſome 35 *s.* $6\frac{1}{2}$ *ſt.* others 35 *s.* 2 *d.* and others $38\frac{3}{17}$ *s.*; but the courſe is allowed by all to run from 30 to 40 ſchillings Flemiſh *per* pound Sterling.

Examples

Examples of exchanges with Antwerp.

Ex. 1. How much Flemiſh will anſwer a London draught of *L.* 374, 19*s.* *Sterling*, exchange at 37*s.* 6*d.* *per* pound Sterling?

374	19	0	for	20		
187	9	6	for	10		
93	14	9	for	5		
46	17	4½	for	2	6	
				37	6	

L. 703 0 7½ Flemiſh. *Anſwer.*

Exam. 2. How much Sterling will anſwer an Antwerp bill of *L* 703:0:7½ Flemiſh, exchange at 37*s.* 6*d.* Flemiſh *per* pound Sterling?

37 6 — 2 — 75 fixpences : 1 :: 703 0 7½ — 40 — 5)28121.25 fixpences. — 5)5624.25 — 3)1124.85 — 374·95=*L.* 374, 19*s.* *Ster.*

In the laſt example one fixpence is added to the product of 40 out of the 7½*d.* and the remaining three halfpence reduced to the decimal of fixpence; the diviſion is made by the component parts of 75.

The different towns in Britain exchange with London for a ſmall premium in favour of the latter, more or leſs, according to the demand for bills; and, in the ſame manner, Antwerp and the other towns in the Netherlands exchange with Amſterdam from 1⅛ to 1½ *per cent.* in favour of Amſterdam, and the calculations in both caſes are made as in factorage. We ſhall give an example of each.

Exam. 1. Glaſgow draws on London for *L.* 760 at 30 days, ⅛ exchange; how much money is received for the draught?

760

3 16 for $\frac{1}{4}$ *per cent.* $=\frac{1}{100}$
19 for $\frac{1}{4}$ *per cent.* $=\frac{1}{4}$ of $\frac{1}{100}$

4 15 exchange at $\frac{1}{4}$

L. 764-15 paid for the bill. *Anſwer.*

Exam. 2. Antwerp draws on Amſterdam for *L.* 760 Flemiſh, exchange at $1\frac{1}{2}$ *per cent.*; how much Flemiſh will pay the bill at Antwerp.

760

7 12 at 1 *per cent.* $=\frac{1}{100}$
3 16 at $\frac{1}{2}=\frac{1}{2}$ of $\frac{1}{100}$

11 8 exchange at $1\frac{1}{2}$

L. 771 8 paid at Antwerp. *Anſwer.*

Art. V. EXCHANGE with HAMBURG.

INTRODUCTION.

Although the funds of the bank of Hamburg are much inferiour to thoſe of the bank of Amſterdam, yet the integrity and exactneſs with which it is conducted, hath procured it a very great reputation all over Europe, and ſtill more particularly in the north,

The inſpection of this bank comes not under the cogniſance of the ſenate; but as the citizens and corporations are ſureties, they chuſe four directors by a majority of voices from among the principal of their own number. Theſe directors muſt ſee that the regulations of the bank be duly obſerved, and impreſs the caſhiers with money without touching the treaſure, when there is a demand. Though the capital of this bank is ſuppoſed to be very conſiderable, yet it is very difficult to conclude concerning it with any degree of certainty; as the clerks and managers are bound to ſecrecy by oath; which hath likewiſe this effect, that no ſeizure can be made of any depoſit or bank account, as no one knows how another ſtands with the bank. None but citizens can have the

the benefit of a bank-account, or of lodging money there by way of depoſit, without intereſt. The leaſt ſum which can be wrote in bank is 100 marks lubs, and every ſum betwixt 100 and 300 marks lubs that is wrote in bank, is taxed with a duty of 2 ſchillings lubs at entry, but any ſum exceeding 300 marks is entered *gratis*.

The ſtated hours of tranſacting buſineſs in the bank are from ſeven to ten in the morning; but the bank is kept open to five in the afternoon for ſuch as have a mind to write in bank at the expence of 2 ſols lubs for each ſum.

Every account that is opened with the bank coſts an expenſe of 50 rix-dollars, or 150 marks lubs. Loans are made out of this bank upon a depoſit of ſilver, jewels, precious ſtones, &c. which are received upon inventory; and if not relieved at the end of ſix months, by paying the principal and a moderate intereſt, they are auctioned at the bar of the bank upon a day advertiſed for their ſale and delivery.

They keep their accounts in the bank, and through the city, either in rix dollars, ſols, and deniers lubs, or in marks, ſols, and deniers lubs. The rix-dollar is worth 3 marks, or 48 ſols lubs, weighing 532 grains.

The livre-gros or pound Flemiſh is equal to $7\frac{1}{2}$ marks lubs, or 20 ſols gros, or 120 ſols lubs.

The mark lubs is divided ſometimes into 32 gros, but more generally into 16 ſchillings lubs, and each of theſe into 12 phennings.

Hamburg exchanges with Britain in ſchillings and grotes Flemiſh, and the par of their rix dollar is reckoned at 4 *s.* 6*d.* *Sterling*, ſo that the par of *L.* 1 *Sterling* is 13 marks 5 ſchillings lubs, 35 *s.* $6\frac{2}{3}$*d.* Flemiſh.

The value of the rix-dollar being every where known, and its ſtandard invariable, it is applied to the valuation of all kinds of merchandiſes as well as coins. The principal current coins in thoſe parts are thoſe of Denmark and Holſtien, Lubec and Hamburg, which, taking them at the par, may be valued as follows.

A tryling $\frac{1}{4}$ of a phenning - -	*L.* 0	0	$0\frac{3}{128}$	*Sterling.*
A ſixling $\frac{1}{2}$ of a phenning - - -	0	0	$0\frac{3}{64}$	
A phenning $\frac{1}{12}$ of a ſchilling lubs	0	0	$0\frac{3}{32}$	
One ſchilling lubs $\frac{1}{10}$ of a mark -	0	0	$0\frac{1}{8}$	
The dollar=2 marks - - - -	0	3	0	
The rix-dollar=3 marks - - -	0	4	6	
The ducat of $6\frac{1}{4}$ marks . . -	0	9	$4\frac{1}{2}$	

The

The current money hath been ſo much adulterated of late years, that the agio hath riſen from 15 to 20, to 30 and 40 *per cent.*; but all bills of exchange are paid in bank.

Examples of exchange with Hamburg.

Exam. 1. London draws on Hamburg for *L.* 500 *Sterling*; how many marks muſt be paid at Hamburg, the exchange at 33 *s.* 6 *d.* Flem. banco *per* pound ſterling?

As 20 *s.* Flem. = $\frac{1}{3}$ marks, it will be 20 : 7.5 :: 35.5
The two firſt terms abridged by 5 4 : 1.5 :: 35.5
1.5

4) 53.25

13.3125 marks
=*L.* 1 *Sterl.*

Hence 1.5 will be a conſtant multiplier, and 4 a conſtant diviſor, for finding the marks contained in the courſe of exchange, equal to a pound Sterling.

L. *marks.* *L.* *m.* *s.*
Then 1 : 13.3125 :: 500 : 6656 4 lubs.

Or in other words, ſince 1 is the firſt term, multiply the marks in one pound by the given number of pounds, and the product anſwers the queſtion.

For 13.3125
500

marks. s.
6656.25=6656 4 lubs. *Anſwer.*

Or by practice thus:

35 6
3

8) 106 6

13 5

Schillings Flemiſh are reduced into marks by multiplying by 6, and dividing by 16; hence the reaſon of this operation, which is only an abridgement of that.

Then 500 *L.*
13 marks.

6500 for 13 marks.
125 for 4 *s.* or $\frac{1}{4}$ of a mark.
31$\frac{1}{2}$ for 1 *s.* or $\frac{1}{2}$ of $\frac{1}{4}$.

6656 4 marks, as before.

Exam. 2. Hamburg draws on London for 6656 marks, 4 ſchillings lubs; what Sterling muſt be paid at London, the exchange at 35 *s.* 6 *d.* Flem. banco *per* pound Sterling?

35·5
1·5

4) 53·25

13·3125) 6659.25 (500 *l. Sterling.* *Anſwer.*
6656.25

(0)

Or by practice, thus,

35 6 | 6656 4
6 | 16

213 |)106500(500 as before.
1065

(0)

Exam. 3. Hamburg is indebted to London in the nett proceeds of a conſignment, amounting to 5600 marks current money; for how much Sterling may London draw, exchange at 36 *s.* Flem. banco, agio 30 *per cent.*?

Cancel a cipher in each of the firſt terms, and then it will be

C. *B.*
13 : 10 :: 5600
10

13)56000

36 | 4333⅓ banco.
3 | 8

98 |)34666⅔ (353.742 *fere* = *L.* 353-14-10
294

526
490

366
294

726
686

406
383

(23)

Exam. 4. When the exchange with Hamburg is at 36 *s.* 6 *d.* Flem. banco *per* pound Sterling, what is the price of the mark lubs?

s. Fl.		*s. lubs.*
20	=	120
10	=	60
5	=	30
1	=	3
0 6	=	3

d.

219 : 240 :: 16

16

219) 3840 ($17\frac{117}{219}$

219

1650

1533

117

OBSERVATION.

When Britain exchanges upon the imaginary price of 1 *l.* Sterling, as with the Netherlands and Hamburg, the Britiſh merchant will find his account, in remitting when the courſe is high, and drawing when it is low; as it is better to get 36 *s.* Flemiſh for a pound Sterling than 35 *s.* If what hath been ſaid in the laſt obſervation has been duly conſidered and digeſted, an example will be ſufficient illuſtration.

Examples of drawing and remitting.

Exam. 1. When the exchange was at 36 *s.* 6 *d.* Flemiſh, Britain remitted to Amſterdam *L.* 5000 *Sterling*, but upon the fall of the exchange to 35 *s.* Flemiſh, Britain drew to be reimburſed; for how much Sterling may Britain draw to bring home this remittance?

Sixpences.

73 : 5000 :: 70

73

7) 365000

L. 5214 5 $8\frac{4}{7}$ *Anſwer.*

Exam. 2. When the exchange was at 36 *s.* 6 *d.* Flemiſh, Britain

Britain remitted to Amſterdam 5000 guilders; but when the exchange fell to 35*s.* Britain drew for the ſame number of guilders; what advantage to Britain attended the negotiation?

Firſt, 36.5
·3
5) 10.95 5000
2.19). 1000.00 (456 12 5. at 36*s.* 6*d.*
876
1240
1095
1450
1314
136
20
2720
219
530
438
92×12=1104
1095

2dly, 35
·3 5000
10.5 3) 1000
2.1 7) 3333.33
Drawn 476 3 9½
Remitted 456 12 5
Gained 19 11 4½

Hamburgh exchanges with other trading nations as follows.

With France, upon the crown of 60 ſols, for 27 ſchil. lubs, more or leſs,
With Spain, upon the ducat of 375 mervadies, for 93 gros, more or leſs,
With Portugal, upon the cruſade of 400 reas, for 42 gros, more or leſs,
With Venice, upon the banc ducat of 24 gros, for 86 gros, more or leſs,
With Vienna, upon 100 Hamburgh rix-dollars banco, for 139 rix-dollars, of the empire, more or leſs,
With Nuremberg, on ditto, for 135 dollars of Nur. more or leſs.
} according to the courſe.

EXAMPLES.

Exam. 1. Reduce 975 marks 2½ ſchillings lubs, bank money of Hamburgh, into livres, ſols, and deniers Tournois of France;

France; exchange at $27\frac{1}{24}$ sols lubs banco *per* crown, of 60 sols Tournois?

Exchange at $27\frac{1}{24}$ 975 $2\frac{1}{3}$
16
649 15602$\frac{1}{3}$
24
649) 394456
Cr. 576 58 5
3
Livres 1730 18 5 French money. *Answer.*

Exam. 2. In 1730 *liv.* 18 *sols*, 5 *den.* how many Hamburg marks, exchange at $27\frac{1}{24}$ sols lubs *per* crown, of 60 sols Tournois?

3) 1730 18 5
Crowns 576 58 5
$17\frac{1}{24}$
4032
1152
$24 = \frac{1}{24}$ of 576
13^1 for 30 sols
9 for 20
$1\frac{3}{4}$ for 4
$1\frac{3}{4}$ for 4
$\frac{1}{16}$ for —4 deniers
4) 15602$\frac{1}{16}$
4) 3900$\frac{1}{2}$
Marks 975 2 *Answer.*

After the same manner may the exchange betwixt Hamburg and any other place, when the exchange is made on the piece, be computed. When the exchange is made on the 100 rix-dollars, the computation is similar to that betwixt Britain and the plantations.

Art. VI. Exchange with France.

Paris and Bourdeaux are the principal places of exchange in

in France; and indeed, in theſe places, the buſineſs of exchange is particularly ſtudied. Accounts are kept throughout the French dominions, in livres, ſols, and deniers, divided as the Britiſh pound. In exchanging with France, we pay ſo many pence Sterling for their crown or ecu of 3 livres, or 60 ſols Tournois. As they have not always any piece of coin of that value, this ideal crown, or crown of exchange, is diſtinguiſhed from the real crown, or ecu d'argent, by the name of the *crown of 60 ſols Tournois*.——The exchange between France and other countries varies more than any other, occaſioned by the frequent alterations of their coin, which is the effect of an arbitrary government. The king may at any time, by an arret, order the money to be recoined, at what number of crowns he pleaſes out of the mark, which muſt render their value variable in other places, whatever value royal authority may ſtamp upon them in France. By the laſt arret of the 15th of June 1726, $8\frac{1}{2}$ crowns are appointed to be coined out of the mark of 7 ounces, 17 pennyweights, and 12 grains Engliſh, and each of theſe crowns to paſs for 6 livres; ſo that, in that caſe, the mark contains 50 livres 5 ſols, which is intrinſically worth 40 *s.* $8\frac{1}{2}$ *d. Sterling*. Wherefore the preſent par of 3 livres, or crown of 60 ſols Tournois, is 29.149 pence Engliſh, and whatever is paid more or leſs than this, muſt be a gain or a loſs. According to this par their coins may be eſtimated as follows:

A denier - - - - - - -	*L.* 0	0	$0\frac{11}{110}$
A liard of 3 deniers - - - - -	0	0	$0\frac{33}{220}$
A dardane of 2 liards - - - - -	0	0	$0\frac{33}{100}$
A ſol of 2 dardanes - - - - -	0	0	$0\frac{33}{50}$
A frank of 20 ſols or 1 livre - -	0	0	$9\frac{1}{4}$
A crown of exchange 60 ſols - -	0	2	$5\frac{1}{4}$
A double crown of 6 livres - -	0	4	$10\frac{1}{2}$
A lewis d'or of 8 crowns - -	0	19	6

They have likewiſe half and quarter crowns, and half and quarter franks.

To compute the exchanges with France.

Caſe 1. If French money is required, let the courſe of exchange in pence be the firſt term, 1 crown or 3 livres according to the requiſition, be the ſecond term, and the given Sterling reduced to pence the third, then will the fourth proportional be the anſwer.

Caſe 2. If Sterling be required, reverſe the laſt rule, or make the calculation by practice.

Theſe

Theſe rules univerſally hold in computing the exchanges with thoſe places where the exchange is made on any fixed piece, the price whereof is determined by the courſe.

When France exchanges with other countries, who have likewiſe a piece of exchange, 100 of the one is given for ſo many of the other, and the calculations made in that proportion.

Examples of the exchanges with France.

Exam. 1. London draws on Paris for *L.* 566 : 13 : 4; how many livres, *&c.* will clear the draught at Paris, the exchange being at 31 *d. per* ecu?

566 13 4
20
11333
12
136000
3 livres

d. livres.
31 : 3 ::

31) 408000 (13161 5 9$\frac{3}{1}$
31
98
93
50
31
190
186
49
31
9
20
180
155
25
12
300
279
21

Exam.

Exam. 2. London received at Paris 13161 livres 5 ſols and $9\frac{3}{7}$ deniers; for how much Sterling was the draught, the exchange being at 31 *d. Sterling per* ecu?

L. 3 : 31 :: 13161.263

31

394837 89

3) 407999·153

12) 135999·717

20) 11333 $3\frac{3}{4}$

566 13 $3\frac{3}{4}$

Or thus 3) 13161 5 $9\frac{3}{7}$

8) 4387 1 11

30) 548 7 9 at 30 *d.*

18 5 7 at 1

L. 566 13 4 *Anſwer.*

Art. VII. EXCHANGE with SPAIN.

The monies of Spain are of two ſorts, the one called *plate money*, and the other *vellon*. A rial vellon is worth in Spain $8\frac{1}{2}$ quarts copper money, and the rial of old plate of exchange is worth 16 vellon, and the effective rial of new plate 17; which makes a difference between theſe two ſpecies of rials as 32 to 17, or $53\frac{1}{8}$ *per cent.*

By the word *plate*, is underſtood ſilver money, wherein ſome of the merchants keep their accounts; and that which is uſed for the negotiation of foreign exchanges is diſtinguiſhed by the name of *old plate*, which is ideal in the ſame ſenſe with the exchange-crown of France, or the pound Sterling of Britain.

The foreign bankers or remitters at Madrid, Cadiz, Seville, *&c.* keep their accounts in piaſtres, rials, and mervadies old plate, reckoning 34 mervadies to a rial, and 8 rials to a piaſtre, the par of which is 3 *s.* 7 *d. Sterling.*

The ſhopkeepers of Madrid, the cuſtomhouſe, and other dealers within the kingdom, keep their accounts in rials and mervadies vellon. Some merchants, particularly in Valencia, keep their accounts in piaſtres, ſols, and deniers, divided as the French livre, or Britiſh pound.

The doubloon of exchange is equal to 4 piaſtres, or 32 rials.

The ducat, or ducado current, is equal to 11 rials old plate,

plate of 374 mervadies; but the ducat of exchange is equal to 375 mervadies.

The piaſtre of exchange is likewiſe reckoned at 15 rials vellon, and 2 mervadies.——It is proper that the drawer of a bill upon Spain ſhould expreſsly ſtipulate the payment to be made either in gold or ſilver, or the bearer of the bill may ſuſtain a loſs of $1\frac{1}{2}$ *per cent.*

The Spaniſh ſilver and copper coins, from the above par, may be eſtimated as follows.

A mervadie - - - -	*L.* 0	0	$0\frac{4}{5}\frac{3}{7}$
A quartil=2 mervadies - -	0	0	$0\frac{4}{1}\frac{3}{3}\frac{3}{6}$
A rial plate=17 quartiles, or 34 mervadies	0	0	$5\frac{3}{4}$
A piſtrine=2 rials plate - -	0	0	$10\frac{3}{4}$
A dollar, old plate of Seville=10 rials - -	0	4	6
A dollar of new plate=8 rials plate -	0	3	7
Mexico ditto - - -	0	4	6
Pillar ditto - - -	0	4	$6\frac{3}{4}$
Peru ditto old plate - - -	0	4	5
A croſs dollar - -	0	4	$4\frac{3}{4}$

The gold coins are piſtoles and their fractions; the piſtole is worth 4 dollars, or 17 *s.* 11 *d.* and the fractions in proportion.

The courſe between Britain and Spain is always below par, from 35 to 40 pence *per* piaſtre.

Examples of exchanges with Spain.

Exam. 1. London remits to Cadiz *L.* 576 : 12 : $2\frac{3}{4}$ *Sterling*, exchange at $37\frac{7}{8}$ *d. per* piaſtre; how much will be received for this remittance at Cadiz?

d.	*piaſt.*	*L.*		
$37\frac{7}{8}$	: 1 ::	576	12	$2\frac{3}{4}$
		20		
303		11532		
		12		
		138386		
		8		
		1107094		

carried forward.

piaſt. ri. mer.

303) 1107094 (3653·775=3653 6 7 *Anſwer.*

909

1980
1818

1629
1515

1144
909

2350
2121

2290
2121

1690
1515

175

Exam. 2. Cadix remits to London 3653 piaſt. 6 ri. 7 mer. at 37$\frac{7}{8}$ exchange *per* piaſtre; what will the remittance amount to in London?

3653·775

$\frac{1}{10}$	365·3775	= 2 *s.*
$\frac{1}{2}$	182·6887	= 1
$\frac{1}{8}$	22·8361	= 1$\frac{1}{2}$
$\frac{1}{4}$	5·7090	= $\frac{1}{8}$
	576·6113	= *L.* 576 12 2$\frac{1}{4}$ *Anſwer.*

Rials vellon are reduced into rials of exchange, and the contrary; piaſtres effective into rials of exchange, and rials vellon, as in the following examples.

Exam. 1. Reduce 5005 ri. 16 mer. vellon to rials of exchange.

ri. mer.
5005 16
$8\frac{1}{2}$

40044 = the product of 8, to which 4 is added for 16 m.
$2502\frac{1}{2}$ = the product of $\frac{1}{2}$

4) $42546\frac{1}{2}$ = the produce of $8\frac{1}{2}$ quarts in a rial vellon.

4) $10636\frac{1}{2}$

$2659\frac{1}{32}$ rials of exchange. *Anſwer.*

Exam. 2. Reduce 2659 ri. 5 mer. of exchange, to rials vellon.

2659 5
16 quarts in a rial of exchange.

8.5) $42546\frac{1}{2}$

Rials 5005 16 mer. vellon. *Anſwer.*

Exam. 3. Reduce 250 piaſtres to rials vellon.

250
8.

2000
$8\frac{1}{2}$

16000
1000

16) 17000

1062 16 mervadies vellon. *Anſwer.*

In moſt of the inland towns of Spain they keep their accounts in mervadies, hundreds and thouſands of mervadies, and exchange upon the ducat of 375 mervadies.

EXAMPLE.

Spain is indebted to Britain in 5745 ℔ 575 mervadies, at 52 *d. Sterling per* ducat of 375 mervadies; how much Sterling will even the account in Britain?

5)

5) 5745 ℔ 575

12) 1149.115 for 4 *s. Sterl.*
96.759 for 4 *d.*

L. 1244.874=*L.* 1244-17-6 *Anſwer.*

Art. VIII. EXCHANGE with PORTUGAL.

In Liſbon, and, in general, throughout the Portugueſe dominions, accounts are kept in milreas and reas, reckoning 1000 of the latter to one of the former The milrea is no real coin, but an imaginary piece of account, of which a cruſado of ſilver contains $\frac{480}{1000}$, or 0 ℔ 480 = 480 reas. The par of a milrea is 5 *s.* 7½ *d.* according to which the gold monies of Portugal are as follows.

The piece of 25 ℔ 600 double Joannes	*L.*	7	4 0
Ditto of 24		6	15 0
Ditto of 12 ℔ 800 ſingle Joannes		3	12 0
Ditto of 12		3	7 6
Ditto of 6 ℔ 400 half Joannes		1	16 0
Ditto of 4 ℔ 800 moidore ſtamped		1	7 0
Ditto of 3 ℔ 200 quarter Joannes		0	18 0
Ditto of 2 ℔ 400 half moidore		0	13 6
Ditto of 1 ℔ 600 ⅛ Joannes		0	9 0
Ditto of 1 ℔ 200 quarter moidore		0	6 9
Ditto of 0 ℔ 800 $\frac{1}{10}$ Joannes or teſtoon piece		0	4 6

The ſilver monies as follow.

The cruſado of 400 reas not ſtamped	*L.*	0	2 3
Ditto of 480 reas ſtamped in 1643		0	2 8⅖
The 12 vintin piece of 240 reas		0	1 0
The 5 ditto of 100 reas		0	0 9
The 2½ vintin of 50 reas		0	0 4½

The copper coins as follow.

The vintin piece of 20 reas		0	0 1½

The half and quarter ditto, according to the ſame proportion.

The courſe of exchange betwixt Britain and Liſbon is betwixt 5 and 5 *s.* 8 *d.*

EXAMPLES.

Exam. 1. London remits to Oporto *L.* 578 : 19 : 6, exchange at 5 *s.* 3 *d. per* milrea; what will be received at Oporto?

s.	*d.*	*m.*		*L.*	*s.*	*d.*
5	3	1	::	578	19	6
4					20	
21 threepen.				11579		
				4		
				3) 46318		
				7) 15439℔333		
				2205℔619 *Answer.*		
				mil. reas.		

Exam. 2. Oporto remits to London 2205℔619, exchange at 5 *s.* 3 *d. per* milrea; how much ſterling will this be reckoned at in London?

4) 2205.619

20) 551.40475 at 5 *s.*
27.5702375 at 3 *d.*

578.9749875=*L.* 578-19-6 *Anſwer.*

Art. IX. EXCHANGE with GENOA.

St. George's bank hath a prodigious ſway in the republic of Genoa, and is conſtituted of ſuch branches of the public revenue as hath been mortgaged by the government for the payment of ſuch ſums as have been borrowed during the exigencies of the commonwealth. The adminiſtration is during life, by which means it hath become a kind of inferiour ſenate, which often breaks the uniformity of their ariſtocratic government.

Accounts are kept in the bank, in piaſtres or pezzoes, which are divided into ſoldi and denari, as the Britiſh pound; but ſome of the merchants keep their accounts in lires or liras, ſoldi and denari, divided as before: this money is only $\frac{1}{5}$ of the value of the other, as the Scots money is $\frac{1}{12}$ of Sterling.

The

The par of { a pezzoe or piaſtre is 54 *d.*
a lire or lira - $10\frac{4}{7}$

According to which their coins may be eſtimated as follows:

A denari - - -	L. 0	0	$0\frac{2}{7}$
A ſoldi or 12 denari - -	0	0	$2\frac{6}{7}$
A chevalet or 4 ſoldi - -	0	0	$1\frac{1}{7}$
A teſtoon or 30 ſoldi - -	0	1	$1\frac{4}{7}$
A genoini or 6 teſtoons	0	6	9
A piſtole - - -	0	15	6
A Spaniſh piſtole - -	0	17	11

The exchange runs between 45 and 50 *d.*

Examples of Exchange.

Exam. 1. In 784 *pez.* 19 *s.* 6 *d.* lire money, how much money of exchange?

	p.	*s.*	*d.*	
5)	784	19	6	lire money.
	156	19	$10\frac{4}{7}$	exchange-money. *Anſwer.*

Exam. 2. Reduce 156 *pez.* 19 *s.* $10\frac{4}{7}$ *d.* exchange-money to lires.

	156 19	$10\frac{4}{7}$
	5	
784	19	6 lire money. *Anſwer.*

Exam. 3. London is indebted to Genoa in *L.* 1710, 16 *s.* 4 *d.*; for how many pezzoes may Genoa value on London, the exchange at $47\frac{1}{2}$ *d.*?

d. $\frac{1}{2}$ *p.* - *pez.* *L.* *s.* *d.* $\frac{1}{2}$ *p.*

$47\frac{1}{2} = 95 : 1 :: 1710\ 16\ 4 = 821192$

s. *d.*

Pezzoes 8644 2 6

Exam. 4. Genoa is indebted to London in 8644 *pez.* 2 *s.* 6 *d.*; for how much Sterling may London value on Genoa, the exchange at $47\frac{1}{2}$ *per* pezzoe?

6) 8644 2 6

8) 1440 13 9 for 40 *d.*
2) 180 1 8½ for 5
90 0 10½ for 2½

1710 16 4 *Answer.*

Exam. 5. London draws on Genoa for *L.* 1710 : 16 : 4 *Sterling*; how much lire money will pay the draught exchange at 48 *d. per* piastre?

1710 16 4
5 times 4 *s.* in a pound Sterling.

Pezzoes 8554 1 8 of exchange.
5 lires in a pezzoe.

42770 8 4 lire money. *Answer.*

Exam. 6. Genoa is indebted to London in 42770 *pez.* 8 *s.* 4 *d.* lire money; how much Serling will this amount to, the exchange at 4 *s. per* pezzoe?

5) 42770 8 4

5) 8554 1 8 pezzoes of exchange.

L. 1710 16 4 *Sterling*, at 4 *s.* exchange.

Art. X. EXCHANGE with LEGHORN.

In Leghorn accounts are kept in piastres, soldi, and denari, divided as at Genoa. Some likewise keep their accounts in liras or lires, divided as the piastre; but this money is only $\frac{1}{6}$ of the money of exchange.

The par with London is 4 *s* 4*d.* but the course runs from 45 to 50 *d.* only

The coins of Leghorn may be estimated as follows:

A denari		*L.* 0 0 0$\frac{13}{240}$
A quatrini,	4 denari	0 0 0$\frac{13}{960}$
A soldi,	3 quatrini	0 0 0$\frac{13}{320}$
A caraca or grain,	5 quatrini	0 0 0$\frac{13}{128}$
A julio or paulo,	8 grains	0 0 5$\frac{7}{9}$
A piastre of exchange		0 4 4

A

A ducat of 150 ſoldi - - - - *L.* 0 5 5
A piſtole of 21 lires - - - 0 15 6

Examples of exchange.

Exam. 1. London draws on Leghorn for *L.* 465 : 19 : 6 *ſterling*; what muſt be paid at Leghorn, the exchange at 46 *d. per* piaſtre?

46 : 1 :: 465 19 6
20

9319
6

23) 55917

Piaſtres 2431 3 5¾ *Anſwer.*

Exam. 2. Leghorn draws on London for 2431 *piaſt.* 3 *s.* 5¾ *d.*; what will pay the bill at London, exchange at 46 *d. per* piaſtre?

40*d.*=⅚ 2431.173958

5*d.*=⅛ 405.195659
1*d.*=⅕ 50.649457
10.129891

L. 465.975007 = 19 : 6 *Anſwer.*

Exam. 3. London is indebted to Leghorn in 7456 *piaſt.* 9 *s.* 6 *d.* lire money; what ſterling ſtands as an equivalent in the London merchants books, the exchange being at 50 *d. per* piaſtre?

6) 7456.475
6) 1242.7458333
4) 207.1243055
51.7810763

258.8053818 *Anſwer.*

By eſtimating the fractions ſometimes above their value, and at other times below the value, as ſeems moſt convenient, perplexing denominators are avoided, and the anſwer found with ſufficient exactitude.

Art.

Art. XI. Exchange with Venice.

The bank of Venice, or banco del giro, is a public depository for the reception of the merchants and traders money, eſtabliſhed by an edict of the republic, enacting, that the payment of merchandiſes by wholeſale, and bills of exchange, is to be made in bank; and that all debtors and creditors ſhall be obliged, the one to carry their money to the bank, and the other to receive their payment in bank, by transfers from the one account to the other: but to remedy the inconvenience that may ariſe for want of ready money to ſatisfy the demands of ſtrangers, or ſupply the neceſſities of a retail-trade, a ready-money bank account hath been opened, for effective payments, which, inſtead of diminiſhing the funds of the bank, hath been found, by experience, greatly to have increaſed them. —The funds of this bank are fixed to 5,000,000 of ducats, for the adminiſtration of which the republic is guarantee. ——The accounts of the bank are kept in livres, ſols, and deniers gros: the livre is equal to 10 ducats bank, or 240 gros, the ducat being equal to 24 gros.

Money of exchange is always underſtood to be that of ducats in bank, which is imaginary, 100 whereof make 120 ducats current money; ſo that the difference betwixt bank and current money is an agio of 20 *per cent.* though the brokers have invented another agio to be added, which is more or leſs according to bargain.

The par of a ducat banco is 4 *s.* 4 *d.* *Sterling*, and the courſe between 45 and 50 *d.*

The Venetian coins are as follow:

A picoli - - -	*L.* 0 0 $0\frac{5}{181}$
A ſoldi, or 12 picoli - -	0 0 $0\frac{60}{181}$
A jule, or 18 ſoldi - -	0 0 $5\frac{75}{181}$
A teſtoon, or 3 jules - -	0 1 $5\frac{163}{181}$
A ducat current, or 124 ſoldi -	0 3 4
A chequin, or 17 lires - -	0 9 2

Lire money is divided as the Britiſh pound, and 1 ducat banco is worth $7\frac{4}{5}$ lires.

Examples of exchange.

Exam. 1. London draws on Venice for *L.* 541, 18 *s.* *Sterling*; how much muſt be paid at Venice, exchange at $45\frac{1}{4}$ *d.* *per* ducat banco?

541 18
20
10838
12
45.625) 130056.000 (2850 duc. 10 s. $10\frac{14}{17}$ d. *Answer.*
91250
388060
365000
230600
228125
24750
20
495000
45625
38750
12
465000
45625
8750

Exam. 2. Venice draws on London for 2850 *duc.* 10 *fol.* $10\frac{14}{17}$ *den.* banco, exchange at $45\frac{5}{8}$ *d. per* ducat; how much Sterling will pay the draught?

6) 2850 10 $10\frac{14}{17}$
8) 475 1 $9\frac{2}{5}$ at 40 *d.*
8) 59 7 9 at 5 *d.*
7 8 $5\frac{1}{17}$ at $\frac{1}{8}$

L. 541 18 0 at $45\frac{5}{8}$ *Answer.*

Exam. 3. Venice is indebted to London in 4789 *duc.* 19 *s.* 3 *d.* current money; how much Sterling may London draw for, agio at 20 *per cent.* when the exchange is at 4 *s.* 1 *d. per* ducat banco?

6 : 5 :: 4789 19 3 current money.

5

6) 23949 16 3

10) 3991 12 8½ banc. money.

2)	399	3	3¼	at	2
	199	11	7⅝	at	1
12)	199	11	7⅝	at	1
	16	12	7⅝	at	1
L.	814	19	2⅛	at	4 1

The firſt two terms are abridged by cancelling the ciphers, and reducing the remaining figures to their loweſt terms.

The foregoing are the remarkable places of exchange in Europe with which Britain hath occaſion to negotiate, as all the other places with which we may have commerce, receive and make payments by the medium of Amſterdam, Hamburg, or Venice; and if the examples of converting the money of one country into that of another have been properly attended to, it may reaſonably be preſumed, when the courſe of exchange is known, that there will be very little difficulty in reducing Sterling to its equivalent value in the money of account in any other country, and the contrary. It will not, however, be improper to add what follows.

I. In DENMARK and NORWAY,

Accounts are kept in marks and ſchillings, reckoning 16 Daniſh ſchillings to a mark; their real monies being proportioned as under.

A rix-dollar	=	6 Daniſh marks.
A Daniſh crown	=	4 ditto.
A double ditto	=	8 ditto.
A rix ort	=	24 Daniſh ſchillings.
An ebrew	=	28 ditto.
A rix-mark	=	20 ditto.
A common ditto	=	16 ditto.
A Daniſh gludſtadt	=	6 ditto.
A foreign ditto	=	5 ditto.

The courſe of exchange with London is betwixt 45 and 58 pence *per*-rix-dollar; with from 12 to 18 *per cent.* in favour

vour of Hamburg to receive rix-dollars for Daniſh crowns; in favour of Amſterdam from 8 to 12, and in France from 75 to 85 rix-dollars *per* 100 crowns.

II. In POLAND,

Some keep their accounts in pence, groſſes, and florins, reckoning 18 pence to 1 groſs, and 30 groſs to a florin; and others in rix dollars and groſſes, reckoning 90 groſs to a rix-dollar.

Their real money is proportioned as under.

			d.	
18 groſſes or groſhen	= 1 ort	=	$10\frac{4}{7}$	*Sterl.*
A ſpecie dollar	= 40 groſhen	= 2		
A rix-dollar	= 5 orts	= 4	6	
A gold ducat	= 6 florins	= 9		

Britain exchanges with Poland conſtantly by the medium of Amſterdam and Hamburg.

III. In RIGA,

Accounts are kept in rix-dollars and groſhen, reckoning 90 groſhen to a dollar.

The ordinary coins are,

A rix-dollar	= 15 Riga marks	= 4	6	*Sterl.*
A Poliſh florin	= 5 Riga ditto	= 1	6	
A Riga mark	= 6 groſhen	=	3	
A vording	= $1\frac{1}{2}$ groſs	=	$\frac{1}{4}$	

The exchange is made with Hamburg at ſo many rix-dollars *per cent.* rix-dollars

IV. In PRUSSIA and DANTZICK.

Accounts are kept in florins groſs, and pence, reckoning 18 pence to 1 groſs, and 30 groſhen to a florin.

The current ſpecie as follow.

A rix-dollar	= 3 florins	= 4	6	*Sterling.*
A goulden	= 30 groſhen	= 1	6	
An ort	= 18 groſhen	=	$10\frac{4}{7}$	
A brummer	= $1\frac{1}{2}$ groſhen	=	$\frac{2}{9}$	
A croſs dollar	= 3 florins 16 groſhen			
A ſpecie dollar	= 3 florins 18 groſhen.			

Pruſſia exchanges with London directly on the rix-dollar, the courſe from 4 to 5 *s.*;—*via* Amſterdam at 40 to 48 ſtivers *per* rix-dollar, or 118 to 130 rix-dollars *per* 100 rix-dollars of 50 ſtivers; and *via* Hamburg at 115 to 135 rix-dollars *per cent.* ditto of 48 ſchillings lubs.

V. In SWEDEN,

Accounts are kept in rix-dollars, copper dollars, and runſticks, reckoning 32 runſticks to a copper dollar, and 6 copper dollars to a rix dollar, the par of which being 4 *s.* 6 *d. Sterling*. The runſtick is only an imaginary piece uſed in their reckoning, but they have copper farthings, 2 whereof make a runſtick; 3 runſticks make 1 whitton, 10⅔ whittons make a copper dollar, 6 copper dollars, or 64 whittons make a rix-dollar.

The copper dollar is likewiſe divided into 4 marks, and each of theſe into 8 runſticks. They have alſo a ſtiver dollar, or Swediſh rix-dollar, of value 2 *s.* 3 *d. Sterling*, divided into 32 ore, and in this ſpecie the cuſtomhouſe receive payment of all duties outward. The duties inward muſt be paid in the Swediſh copperplate dollar, value 4 *s.* 6 *d.* divided into 48 ore.———The exchange with London is generally by Hamburg or Amſterdam, and ſometimes directly in which caſe they reckon the copper dollar par with our ſhilling, but the courſe runs about 28 to 30 copper dollars for the *L.* Sterling.

VI. In RUSSIA,

Accounts are kept, eſpecially by the merchants of Archangel and Peterſburg, in rubbles and copecks, and ſometimes in copecks, grieveners, and rubbles. The current monies as follow:

3 copecks	=	1	altin
10 copecks	=	1	grievener.
25 copecks	=	1	polpaltin.
50 copecks	=	1	poltin,
100 copecks	=	1	rubble.
2 rubbles	=	1	ducat.

The rubble is worth betwixt 4 and 5 ſhillings Sterling, and our crown piece paſſes for 120 and ſometimes 130 copecks.

The

The duties are all paid in good foreign money by the weight.

The exchange is made with Hamburg at an uncertain number of copecks for the rix-dollar, and with Amſterdam at an uncertain number of ſtivers for the Ruſſian rubble.

VII. In Turkey,

Accounts are kept in lions, dollars, and aſpers, reckoning 80 aſpers to a dollar, and by theſe two all their other coins are rated. Here they receive in payment the ſpecie of every other country by the weight, provided the gold and ſilver is good.

The current monies are as follow:

A gold checkeen or cheffin is worth 243 aſpers.
An aſper is worth $\frac{7}{10}$ of 1 penny ſterling.
A Venetian checkeen worth 280 aſpers.
A Hungarian ditto——from 240 to 250 aſpers.
A piece of eight from 100 to 110 aſpers.
German dollars from 110 to 120

VIII. In Persia,

They reckon 10 goz to 1 ſhabee, 2 ſhabees to 1 mamodre, 2 mamodres to 1 abaſſee, and 7 abaſſees to 1 ſequin.

The par of 1 goz is 4 *d.* and the others in proportion.

IX. In Arabia,

Their only coins are the aſper, value ſomething leſs than a penny Sterling, the dollar whoſe value runs betwixt 60 and 80 aſpers, and the ſequin of 100 aſpers or 8 *s.* Sterling.

X. In Bengal in the East Indies,

12 ree make 1 ana, and 16 ana 1 rupee = 2 *s.* 6 *d.* Sterling.

XI. In China,

10 caſh make 1 canderine, 10 canderines 1 mace, and 10 mace 1 tale = 6 *s.* 8 *d.* Sterling.—They have no coined pieces here, but pay in gold and ſilver by weight, which they denominate by talents and meaſure.

XII. In

XII. In JAPAN,

They have a piece of gold, value *L.* 6 : 11 : 3, another piece of about *L.* 2 : 3 : 9, and ſeveral ſilver pieces of different weights. They have but one copper piece, value $3\frac{1}{2}$ Dutch guilders.

Their gold is worth 63 *s. per* ounce, and their ſilver 5*s. per* ounce.

XIII. In EGYPT,

The gold coins are, the ſultany, xeriff, and ſequin, each eſtimated from 9 *s.* 4 *d.* to 9 *s.* 6 *d.* The ſilver coins are the Spaniſh dollar, and the muden, an Ottoman piece.

Accounts are kept by the natives in aſpers and mudens, reckoning 3 of the former to 1 of the latter; and by the Chriſtians in Aſpers, and dollars divided into 30 aſpers.

XIV. In BARBARY,

They keep their accounts in dollars and aſpers, reckoning 80 aſpers to 1 dollar.

They have the ſultany, the Venetian ſequin, and the Spaniſh piſtole in gold, which riſe and fall in their value according to the times.

OBSERVATION.

When Britain exchanges on the piece of foreign money, as the French crown, Venetian ducat, *&c.* Britain ought to remit when the exchange is low, and draw when it is high, to negotiate with advantage. The reaſon will be obvious, for *L.* 100 will go farther in purchaſing ducats, crowns, milreas, *&c.* when the courſe of exchange is at 40 *d.* than when it is at 50 *d.* and 100 crowns will go farther in paying a debt due by France to London when the exchange is at 32*d.* than when it is only at par.

EXAMPLES.

Exam. 1. London is indebted to France in 1000 crowns, for payment of which one bill of 500 crowns is purchaſed at $31\frac{1}{2}$ *d.* and another at 30 *d.* for the remaining 500; how

much

much Sterling was paid for the bills, and what difference *per cent.* in the purchaſe?

Cr.

Firſt, 500 exch. at 31½ 2dly, 30 : 1.5 :: 100

8) 500 1.5

2|0) 62 10 at 30 *d.* 30) 150.0

3 2 6 at 1½ *d.* 5 *per cent.* diff.

65 12 6 at 31½ *d.*

62 10 0 at 30 *d.*

L. 128 2 6 was paid Sterling.

Exam. 2. When the exchange was at 5 *s.* London remitted to Portugal *L.* 500 *Sterling*, but when the exchange roſe to 5 *s.* 6 *d.* London drew to be reimburſed of this remittance; for how much Sterling was the bill ſold?

Sixpences. L. Sixpences.

10 : 500 :: 11 Or 500×4=2000 mil. at 5 *s.*

11 11

10) 5500 40) 22000

L. 550 *Anſwer.* *L.* 550 *Sterling.*

Exam. 3. When the exchange was at 31 *d.* Britain remitted to France 1000 crowns, but when the exchange roſe to 32 *d.* Britain drew for the ſame number of crowns; what was paid for the remittance, and how much was received for the draught?

1000 crowns at 31 *d.*

125 at 30 *d.*

4 3 4 at 1 *d.*

L. 129 3 4 paid at 31 *d.*

4 3 4 at 1 *d.*

133 6 8 rec^d at 32 *d.*

Note, In exchanging with the other places of Europe not mentioned, we uſe the medium of Amſterdam and Hamburg, which hath rendered Amſterdam deſpotic in the article of exchanges.

Variety

Variety XII. ARBITRATION of EXCHANGES.

INTRODUCTION.

THE Lombards, one of the many nations that eſtabliſhed themſelves in Italy after the ruin of the Roman empire, and who have beſtowed their name upon one of the fineſt countries in it, were the firſt who ſtudied and ſtruck out this new path of commerce to themſelves, which hath ſince been found not only advantageous to thoſe who thoroughly underſtand, and properly proſecute it, but of peculiar importance to trade in general. The way thoſe ingenious people went to work was this: They entered into partnerſhip, kept houſes in moſt of the trading cities of Europe, at each of which ſome one of the partners conſtantly reſided, and by keeping a regular correſpondence one with another, concerning the ſtate of trade, and the exchanges in their reſpective cities, they ſo managed this new branch of buſineſs, that their houſes ſoon became great and reputable, their capitals large, and the cities in which they reſided opulent and populous, by being made the centre of their exchanges.

To be quick and accurate in arbitrating exchanges, a perfect acquaintance with, and a thorough practice in all the computations in the preceding part of this treatiſe will be requiſite; to which muſt be added, a knowledge of the intrinſic value of foreign monies, according to the moſt accurate aſſays which have been made for that purpoſe.

A knowledge of the natural cauſes of the riſe and fall of the courſe of exchange between nation and nation, or between one trading city and another of the ſame nation, will contribute not a little to the purpoſes of arbitration.

That the courſe of exchange is the touchſtone by which the ſtate of trade can be infallibly diſcovered, hath been allowed not only by great ſtateſmen, and ſpeculative politicians, but by the moſt ſkilful and ſagacious practical traders; and therefore it is the buſineſs of every exchange-negotiator, who would make the moſt of this delicate branch, to conſider with attention, where the balance of trade lies among the European nations, at all points of time; for by that means only he can embrace his opportunities of profit; and theſe almoſt daily betwixt ſome nation or other, provided he hath a credit and correſpondence extenſive enough for the purpoſe. It very rarely happen, in a compariſion of the courſes of exchange,

among ſeveral places together, that they are found to ebb and flow in an exact equality of proportion; for as the balance of trade differs between different nations, ſo the courſe of exchange will be in favour of ſome, and againſt others. This being the caſe, the judgement of the exchange-negotiator conſiſts in vigilantly obſerving, from a proper compariſion of the courſes of exchange, where the greateſt inequality of proportion lies, that he may thereby diſcover with certainty, where he will find his account in drawing and remitting to ſome places preferably to others; for where-ever the greateſt inequality is found, it is there, that negotiations of this kind will be attended with the greateſt profit; and by following this inequality, and altering the channel of his correſpondence with the fluctuation of the exchanges, he will daily improve his fortune, enliven trade, by his intelligence and correſpondence, open new paths of commerce, and be an inſtrument of making the place he lives in more conſpicuous, by being the centre of his exchange-negotiations.

SECT. I. *Simple arbitration of exchanges.*

Caſe 1. When a factor hath orders from his employer to remit a certain ſum of money to a place, provided he can do it, at a certain price of exchange mentioned, and at the ſame time, to draw for his reimburſement upon ſome other place at a certain price of exchange; to find whether the advantage in performing the one part of the commiſſion will be ſufficient to compenſate for the loſs that may ariſe from the other; ſo that, in caſe he finds the negotiation would be to his conſtituent's loſs, he may write him for new orders, or wait till the courſe of exchange be more in his favour; obſerve the following

RULE

Let the price of exchange aſſigned for remitting be the firſt term, the price of exchange aſſigned for drawing be the ſecond term, and the real courſe at which the remittance can be made, the third term; then will the fourth proportional give the price at which the draught ought to be made, to be at par with the price of the remittance.

By comparing which with the price of bills upon that place where the draught is to be made, the factor or correſpondent will eaſily ſee, whether he ought to obey the order or not.

EXAMPLES.

Exam. 1. A factor at London receives an order to remit to Venice 1000 ducats, at 4 *s. Sterling per* ducat, and for this purpoſe, to put himſelf in caſh by drawing on Spain at 3 *s.* 2 *d. per* piaſtre; when this order came to hand, bills for Venice were at 50 *d.*; at what price muſt London draw upon Spain to compenſate the advance on the remittance to Venice by the riſe of the exchange?

d.		*d.*		*d.*
48	:	50	::	38
12		25		19
		19		
		475		

12) 475

$39\frac{7}{12}$ *per* piaſtre, advance $1\frac{5}{12}$.

OBSERVATION.

Since the factor, agreeable to the courſe of exchange, at the time he received the order, is obliged to remit at 50 *d.* which is 1 *d.* advance on each ducat, he muſt draw $39\frac{7}{12}$ *d.* for his piaſtre, otherwiſe his employer would be a loſer in whatever he drew below that price: but if bills on Spain had riſen more in proportion than bills on Venice, for inſtance, to 40 *d. per* piaſtre, the order could be performed with $\frac{5}{12}$ *d.* advantage on each piaſtre.

For, firſt, 1000 ducats at 4 *s.* $=\frac{1000}{1}=L.\ 200$

2dly, *L.* $200=\frac{4800}{38}$ *d.* in a piaſtre $=1263.158$ piaſtres.

That is, the factor in London muſt ſell 1263.158 of his conſtituent's piaſtres before he is put in caſh to make the remittance of 1000 crowns; but when he finds the courſe of exchange hath varied ſince his employer's intelligence, he may firſt find what money the purchaſe of 1000 ducats will require at 50 *d.*; and ſuppoſing the courſe with Spain had riſen to 40, he can ſave of the money ariſing from the ſale of his conſtituent's piaſtres about *L.* 2 : 10 : $3\frac{1}{2}$ *d.*

Exam. 2. An order comes to Amſterdam to remit to Genoa at 82 *d. per* pezzoe, and draw upon London at 33 *s.* 4 *d. per l Sterling*; when the order came to hand, bills for Genoa were at 85 *d.*; how muſt the pound Sterling be valued, to compenſate the loſs by the remittance to Genoa?

$$82 : 33\tfrac{1}{4} :: 85$$
$$33\tfrac{1}{4}$$
$$2805$$
$$28\ 4$$
$$82)\ 2833\ 4$$
$$34\ 6\tfrac{5}{82}$$

Conſequently Amſterdam muſt ſell the London bill at 34 *s.* $6\frac{5}{82}$ *d.* to be at par; whatever is below that, would be a loſs; and whatever is above it, a profit.

Exam. 3. A merchant in Amſterdam is indebted to London in a certain ſum, which he orders his friend at Paris to remit at 30 *d. per* crown, and to value on him for his reimburſement at 54 grotes *per* ecu; upon receipt of the order, he cannot purchaſe a London bill under $30\frac{1}{2}$ *d.* but he can ſell a bill on Amſterdam at $54\frac{3}{4}$ grotes; whether can the order be obeyed with loſs or profit?

d.	*grotes.*	*d.*
30	: 54 ::	$30\frac{1}{2}$
		9
5	9	
		$5)\ 274\frac{1}{2}$
		$54\frac{7}{10}$ grotes. *Anſwer.*

Hence this order can be performed with profit; becauſe, if the remittance to London be at $30\frac{1}{2}$ *d.* the draught on Amſterdam may be in proportion to the order at $54\frac{7}{10}$ grotes; but the crowns remitted to London may be paid at Amſterdam with leſs money, ſince the courſe is only at $54\frac{3}{4}$.

Exam. 4. Rome is indebted to Naples in 3000 ſtamped crowns; for recovering which debt, Naples gives an order to Lyons to draw upon Rome at 42 ſtamped crowns for 100 French crowns; and reſerving $\frac{2}{3}$ for commiſſion, to remit the proceeds to Naples, at $75\frac{3}{4}$ ducats *per* 100 crowns; when this order came to hand, bills for Naples were at $74\frac{3}{4}$; how muſt Lyons draw upon Rome, ſo as to remit to Naples the number of ducats intended by the order, and ſave $\frac{2}{3}$ commiſſion?

$75\frac{1}{2} : 42 :: 74\frac{3}{4}$

6 6

453 448

42

896

1792

453) 18816 (41.5364

1812

696

453

2430

2265

1650

1359

2910

2718

1920

1812

(108)

Hence Lyons muſt draw upon Rome at $41.5364 = 41\frac{17}{75}$ nearly; as will appear more intelligibly in the following proceſs.

42 : 100 :: 3000

100

6) 300000

7) 50000

7142.857 French crowns.

.004

28.571428$\frac{3}{7}$ *per cent.* commiſſion.

7114.285572 nett proceeds to be remitted.

$75\frac{1}{2}$ *per* 100.

3557142786

49799999004

$\frac{1}{2}$ 3557142786

5371.28560686 ducats to be remitted to Naples according to the order at 42 to Rome, and $75\frac{1}{2}$ to Naples.

Naples; and if the amount at 41.5366 crowns to Rome, and at 74¾ ducats to Naples, be found in the ſame manner, the ſame number of ducats will come out in the proceſs as before.

Exam. 5. Amſterdam is indebted to Glaſgow in 1000 guilders as a balance of nett proceeds, which Glaſgow can diſpoſe of at 22 *d. per* guilder; but to make a trial in the exchange-way, orders M. Chapelle at Paris to value on Amſterdam at 54¼ grotes *per* crown, and remit the proceeds to Mr. Adair, London, reſerving ½ commiſſion for his trouble at the current courſe; when this order came to hand, the courſe had not altered, and the commiſſion was executed according to order; the courſe of exchange betwixt London and Paris was at 32 *d. per* ecu, at which exchange Mr. Adair receives bills of exchange upon London, which Glaſgow is accordingly adviſed of, and draws for, with the advantage of 2 *per cent.* for the London bill.——What is the difference of theſe tranſactions to Glaſgow of ſelling the guilders, or being remitted *via* Paris?

guild.	*d.*	
Firſt, 1000 at	22	12) 1000
		10) 83 6 8 for 20 *d.*
		8 6 8 for 2

Glaſgow would draw *L.* 91 13 4 by ſelling the guilders.

2dly, 1000×40=40.000 *grotes.*

4 crowns

54¼=219) 160000 (730.5936 received by the draught on Amſterd.
1533 3.6529 to be deducted for ½ commiſſ.=$\frac{1}{200}$.

670
657
726.9407 to be remitted to London at 32 *d. Ster.*

1300
1095
90.8676 at 30 *d.*=$\frac{1}{8}$
6.0578 at 2 *d.*=$\frac{1}{15}$ of $\frac{1}{8}$
96.9254 remitted to London.

2050
1971
.4746 to be deducted for commiſſ. at London.
96.450 nett at London

790
657
1.889 premium received for the London bill [at 2 *per cent.*=$\frac{1}{50}$.
98.339

1330
1314
20
6.780

(16)
12
9.360
4
1.440

Hence

Hence Glaſgow receives, by negotiating the 1000 guilders at Paris, - - L. 98 6 9$\frac{1}{2}$
And would have cleared by ſelling the guilders but - - - - 91 13 4
So that there is a profit ariſing by the tranſaction of - - - - L. 6 13 5$\frac{1}{2}$
Which will be found to be 5$\frac{1}{17}$ *per cent.* difference.

Caſe 2. To find the arbitrated price of exchange.

The prices of exchange from one place are always given to other two places, in order to find the price of exchange betwixt thoſe two places proportional to the prices given, which is called *the arbitrated price of exchange*, or, *the par by arbitration.*

In this caſe, the 1ſt and 3d terms muſt belong to the ſame country, and the 2d muſt be of that kind of which the price is required; the term which moves the queſtion being always the 3d, the diſpoſition of the terms will eaſily be diſcovered, and the 4th proportional is the par by arbitration.

Examples of arbitrating the par.

Exam. 1. Suppoſe bills at Paris on London at 32 *d. per* crown, and on Amſterdam at 54 grotes *per* crown; what muſt the price of exchange be betwixt London and Amſterdam, to be on a par with the exchange betwixt Paris and thoſe places?

d. Ster.		*grotes.*		*s.*
32	:	54	::	20
4		27		5
		5		
		4) 135		
		s. d.		
		33 9 Flem.		*Anſwer.*

Exam. 2. Suppoſe bills at London on Amſterdam are at 33 *s.* 9 *d.* Flemiſh *per* pound Sterling, and on Paris at 32 *d. per* ecu; what muſt the price of exchange between Amſterdam and Paris be, to make it on a par with the other two?

d. Ster.		*d. Flem.*		*d. Ster.*
240	:	485	::	32
30		4		4

3) 162.0

54 grotes *per* ecu, as in the firſt example.

Exam. 3. Suppoſe bills at Amſterdam on Paris are at 54 grotes *per* ecu, and on Britain at 33 *s.* 9 *d.* Flemiſh *per* pound Sterling; what muſt be the price of exchange betwixt Paris and London, to be on a par with the other two?

d. Flem.		*s. Ster.*		*d. Flem.*
405	:	20	::	54
81		4		4

81) 216

2 *s.* 8 *d.*=32 *d. Sterl.* as before.

Hence, if a draught for *L.* 200 *Sterling* were remitted to Paris at 32 *d. per* crown, it would be found to get credit there for 1500 crowns till they were remitted to Amſterdam, when Amſterdam would be debited for the ſame number of crowns at 54 grotes, which would find credit there for 2025 guilders; and if theſe guilders were remitted to London at 33 *s.* 9 *d.* Flemiſh *per* pound Sterling, Amſterdam would be credited for a remittance of *L.* 200 *Sterling*, which would even the account at all thoſe places, with reſpect to this negotiation, without loſs or profit.

OBSERVATION.

For the ſpeculation of the ingenious merchant on the uſe to be made of the arbitrated par of exchange, it will not be improper to give ſome examples, from the London courſe upon ſuch places where the profit is ſeldom leſs than what follows, *viz.*

Suppoſe London draws on Amſterdam at 34 *s.* 10 *d.* Flemiſh *per* pound Sterling, and on Paris at 31$\frac{1}{8}$ *d. per* ecu, the arbitrational price between Amſterdam and Paris will be found to be 55$\frac{1}{64}$. But ſuppoſe Amſterdam adviſes, that the exchange for Paris is at 54$\frac{1}{4}$ grotes *per* ecu, which is below the arbitrational price, the queſtion is, what profit preſents?

Draw

Draw *L.* 100 *Sterling* on Paris at $31\frac{7}{8}$, it will debit you at Paris for 752 *cr.* 56 *s.* 5 *d.* and remit to Amſterdam *L.* 98 : 12 : 5 at 34 *s.* 10 *d.* Flemiſh, which credits you at Amſterdam with 1030 *guil.* 11 *ſt.* 12 *pen.* banco; ſo that the profit to be made between thoſe places on *L.* 100 is *L.* 1, 7 *s.* 7 *d.* The money received for your draught furniſhes you with money to pay for your remittance, and your debit at Paris will be cleared by your credit at Amſterdam, exchange at $54\frac{1}{4}$ grotes *per* ecu: for if $54\frac{1}{4}$ grotes will pay a French crown, 1030 *guil.* 11 *ſt.* 12 *pen.* bank-money will pay 752 *ecus*, 56 *s.* 5 *d.*

But if, on the other hand, Amſterdam adviſes you at London that the exchange for Paris is at $56\frac{2}{4}$, which is above the arbitrated price of exchange; in this caſe you muſt alter your courſe of drawing, and inſtead of France as before, draw on Amſterdam for *L.* 100 *Sterling* at 34 *s.* 10 *d.* Flemiſh, which debits you at Amſterdam in 1045 guilders banco, and remit to Paris *L.* 98 : 13 : 10 at $31\frac{7}{8}$, which credits you at Paris in 743 *ecus*, 6 *s.* 8 *d.*; ſo that the profit, upon this ſuppoſition, will be *L.* 1 : 6 : 2 on the *L.* 100. And the money you receive for your draught furniſhes you with the money to pay for your remittance as before, your debit at Amſterdam will be paid by your credit at Paris, exchange at $56\frac{1}{4}$: for if one French crown will pay $56\frac{1}{4}$ grotes at Amſterdam, 743 *ecus*, 6 *s.* 8 *d.* will pay 1045 bank guilders.

Hence it is evident, that whether the adviſed price be above or below the arbitrational price, there is always an advantage to be made by drawing and remitting; and as it very ſeldom happens that the adviſed and arbitrational price are at par, advantageous opportunities of doing it may occur every poſt.—In the foregoing example the difference is ſuppoſed to be only that betwixt $55\frac{3}{64}$ and $54\frac{1}{4}$ in one caſe; and in the other that between $55\frac{3}{64}$ and $56\frac{1}{4}$, which is very ſmall; and yet, when it is conſidered how many times it may be reiterated in the year, without the advance of a ſingle ſhilling, it yields a profit ſuperiour to moſt other trades in which a man can be employed.

For another inſtance: Let it be ſuppoſed that London exchanges on Amſterdam at 34 *s.* 10 *d.* Flemiſh, and on Hamburgh at 33 *s.* 5 *d.* the arbitrational price will be found to be $33\frac{143}{167}$ betwixt Amſterdam and Hamburg.——If in this caſe the adviſed or real price of exchange be below the arbitrated par, ſuppoſe for inſtance at 32 *s.* then draw on Hamburg for *L.* 100 at 33 *s.* 5 *d.* which debits you there for 1253 *marks*,

2 *s.* lubs, and remit to Amſterdam *L.* 95 : 18 : 7 at 34 *s.* 10 *d.* which credits you at Amſterdam in 1002 *guil.* 10 *ſtiv.* bank-money: but you received *L.* 100 for your draught on Hamburg, and paid only for your bill on Amſterdam *L* 95 : 18 : 7, ſo that you retain in your own hands a profit of *L.* 4 : 1 : 5 in negotiating in this manner *L.* 100

But if, on the other hand, Amſterdam adviſes that the exchange betwixt Hamburg and there is at $34\frac{1}{2}$, which is above the arbitrated price, then draw on Amſterdam for *L.* 100 *Sterling*, at 34 *s.* 10 *d.* where you will be debited for 1045 guilders banco, and remit to Hamburg *L.* 97 : 7 : 10 at 33 *s.* 5 *d.* where you are credited in 1220 *mar.* 7 *s.* 6 *pen.* lubs; ſo that, without being one ſhilling in advance, you have *L.* 2, 12 *s.* 2 *d.* in your pocket for half an hour's trouble in negotiating *L.* 100: for the money you receive for your draught pays that for your remittance, and your debit at Amſterdam will be evened by your credit at Hamburg, exchange at $34\frac{1}{4}$; for if one dollar of Hamburg will pay $34\frac{1}{4}$ ſtivers at Amſterdam, 1220 *mar.* 7 *s.* 6 *pen.* lubs will clear 1045 guilders banco of Amſterdam.

From theſe examples it will be obvious, that an extenſive credit, and a thorough knowledge in the arbitration of exchanges, makes a ſufficient capital to carry on this beneficial branch; and it is pity ſo few apply themſelves to a ſtudy which would in ſo ample a manner requite their labour.

SECT. II. *Compound arbitration of exchanges.*

When the price of exchange is given betwixt one country and another, betwixt that ſecond and a third, and betwixt that third and a fourth, *&c.*; to find the arbitrated price betwixt the firſt and the laſt, obſerve the following

RULE.

Place the antecedents in one column, and the conſequents in another, to the right of the antecedents, ſo as to form a numerical equation, in the algebraic way of analyſis, in which the firſt antecedent and the laſt conſequent, to which an antecedent is required, muſt always be of the ſame denomination or ſpecies; the firſt conſequent muſt be of the ſame denomination with the ſecond antecedent; the ſecond conſequent with the third antecedent, *&c.* throughout. If a fraction is annexed to any of the numbers, both the antecedent and conſequent muſt be multiplied into the denomination

of that fraction, and the proportion will ſtill be the ſame. The terms being thus diſpoſed, cancel the quantities that are the ſame on both ſides of the equation, and abridge ſuch quantities as are commenſurable, then multiply all the antecedents into one another for a general diviſor, and all the conſequents for a general dividend; and the quotient will be the anſwer, or value of the antecedent required.

Examples of compound arbitration.

Exam. 1. Suppoſe London is to remit *L.* 500 to Spain by the way of Holland at 35 *s. per* pound, thence by the way of France at 58 grotes *per* crown, thence to Venice at 100 crowns *per* 60 ducats banco, and from Venice to Spain at 360 mervadies *per* ducat banco; how many piaſtres of 272 mervadies will it amount to in Spain, excluſive of charges?

(1.)		(2.)
Antecedents.	Conſequents.	1 = 210
1 pound	= 420 *d.* Flem.	29 = 1
58 grotes	= 1 crown.	1 = 30
100 crowns	= 60 ducats.	1 = 45
1 ducat	= 360 mervadies.	17 = 1
272 mervadies	= 1 piaſtre.	5

How many piaſtres for *L.* 500?

Cancel the ciphers in 100 and 500, divide 272 and 360 by 8, and you will have for a new antecedent 34, and for a new conſequent 45; divide 34 and 60 by 2, and you will have a new antecedent 17, and a new conſequent 30; laſtly, divide 58 and 420 by 2, and you will have the new antecedent 29, and new conſequent 210; then will the whole ſtand abridged as in the ſecond equation, and the operation be as follows.

210
30
6300
45
315
252
29 283500
17 5
493) 1417500 (2875$\frac{1}{4}$ piaſtres. *Anſwer.*
493)

493) 1417500 (2875¼ piaſtres. *Anſwer.*
986

4315
3944

3710
3451

2590
2465

(125)

Hence upon the ſuppoſition that 42½ *d.* had been the price of the piaſtre at the direct courſe, the *L.* 500 would only have been worth 2823½ piaſtres; ſo that, by this method of negotiating, there would be a gain of 52 piaſtres, or 2 *per cent.* without reckoning charges.

Exam. 2. A banker in Paris remits to his factor in Amſterdam 455 crowns Tournois; firſt to London at 30 *d. per* crown; from London to Rome at 65 *d. per* ſtamped crown; from Rome to Venice at 100 ſtamped crowns for 140 ducats banco; from Venice to Leghorn at 100 ducats banco for 100 piaſtres of Leghorn: and from Leghorn to Amſterdam at 86 grotes *per* piaſtre; how many guilders banco will be received at Amſterdam without reckoning charges?

Antecedents.	Conſequents.
1 crown	= 30 pence.
65 pence	= 1 ſtamped crown.
100 ſtamped crowns	= 140 ducats.
100 ducats	= 100 piaſtres.
1 piaſtre	= 86 grotes.
How many grotes	= 455 crowns?

Four ciphers on each ſide of the equation being cancelled, and the other quantities being abridged, the operation will ſtand thus:

$$\frac{3\times14\times86\times91}{13\times40} = 632 \text{ guilders and 2 ſtivers.}$$ *Anſwer.*

Exam. 3. Amſterdam being to remit to London *L.* 750 Flemiſh, ſends it firſt to France at 54 grotes *per* crown, thence to Venice at 100 crowns for 56 ducats banco, thence to

Hamburg at 100 grotes *per* ducat, thence to Portugal at 45 grotes *per* cruſado of 400 reas, and from Portugal to London at 5 *s.* 3 *d. per* milrea; how much Sterling muſt be received in London for the remittance, and whether more or leſs than by a direct remittance, exchange at 35 *s.* 6 *d. per* pound Sterling, diſcounting commiſſion at each place of $\frac{1}{2}$ *per cent.*?

Antecedents.		Conſequents.
54 grotes	=	1 crown.
100 crowns	=	56 ducats.
1 ducat	=	100 grotes.
45 grotes	=	400 reas.
1000 reas	=	63 pence.
How much Sterling	=	750 pound Flemiſh?

The five ciphers on each ſide of the equation being cancelled, and the other quantities abridged, we will have the following numbers on each ſide.

Ant.	Con.
9	28
	4
	7
	5

Therefore $\frac{28\times4\times7\times5}{9}$ = *L.* 435.555 *Sterling.*

.02 for commn at 4 places at $\frac{1}{2}$ *per c.* each = $\frac{4}{2}$ = 2 *per c.*

8.711 to be deducted.

426.8444 nett proceeds.

If remitted directly
1.775 : 1 :: 750 : 422.5352

4.3092 nett gain.

Exam. 4. A merchant of London hath credit for 1360 piaſtres of Leghorn, from which there is advice that a remittance can be made at 50 *d. per* piaſtre. The London merchant finding he could make no more by drawing for them, orders them to be remitted in the following manner, *viz.* firſt to Venice at 94 piaſtres for 100 ducats banco, thence to Cadiz at 320 mervadies *per* ducat, thence to Liſbon at 630 reas *per* piaſtre of 272 mervadies, thence to Amſterdam at 50 grotes *per* cruſado of 400 reas, from thence to Paris at 56 grotes *per* crown, and, laſtly he brings them home at 31$\frac{1}{2}$ *d. per* crown: what will be the arbitrated price *per* piaſtre between London and Leghorn, and how much will be received at London without reckoning charges?

Antecedents.

Antecedents:		Conſequents.
94 piaſtres	=	100 ducats.
1 ducat	=	320 mervadies.
272 mervadies	=	630 reas.
400 reas	=	50 grotes.
3 crowns	=	94 pence *Sterl.*=3×31⅓.
How many pence	=	1 piaſtre?

Two ciphers on each ſide of the equation being cancelled, and the remaining quantities properly abbreviated, the operation will ſtand

$$\frac{35\times15\times5}{34}=55\tfrac{5}{34}$$ inſtead of 50 *d.* by a direct remittance.

Hence 1360 piaſtres at the arbitrated price	=	*L.* 312 10 0
Ditto at the direct courſe, *viz.* 50 *d.*	=	283 6 8
Gained by the negotiation,		*L.* 29 3 4

Exam. 5. Suppoſe you are preſented at Amſterdam with bills of exchange upon Naples, for which an exchange of 82 ſols *per* ducat of 10 carlins is required: ſuppoſe likewiſe, before you purchaſe theſe bills of exchange, you would know how many ſols you can afford to give for every ducat, after a circulation through ſeveral places, and paying ½ *per cent.* commiſſion to each correſpondent through whoſe hands the money ſo circulates, for his trouble of negotiating: ſuppoſe likewiſe, you find, that Naples, which is the chief object of conſideration, exchanges with Rome, by giving 124 ducats *del regno* for 100 Roman crowns; that Rome retains a commiſſion, and exchanges with Venice, by giving 62 crowns *d'eſtampe* for 190 ducats banco; that Venice exchanges with Amſterdam, by taking 90 deniers gros for the ſaid ducat, and alſo reſerves commiſſion; that Amſterdam exchanges with Madrid at 96 deniers gros *per* ducat of 375 mervadies, and retains the commiſſion; and laſtly, that Madrid exchanges with Lyons at 76 ſols *per* piaſtre of 272 mervadies of plate, and retains commiſſion: theſe things previouſly ſuppoſed, the queſtion is to ſatisfy the purchaſer of the bills, whether he can diſpoſe of them again in this manner with advantage?

Antecedents.		Conſequents.
124 Naples ducats	=	99½ Roman crowns, ded. comm^{n}.
62 crowns *d'eſtampe*	=	99½ Venetian ducats, comm^{n} ded.
1 ducat	=	89,9/10 gros, commiſſion deducted.
96 deniers gros	=	373⅛ mervadies, comm^{n} deducted.
272 mervadies	=	76 ſols of Lyons.
How many ſols	=	1 ducat of Naples?

The

The antecedents and consequents being ranged, abridged, l cancelled, the consequents multiplied continually for a idend, and the antecedents for a divisor, the value of the cat will be found to be 83 sols, which will not answer the gotiator's end in being several months out of his money.

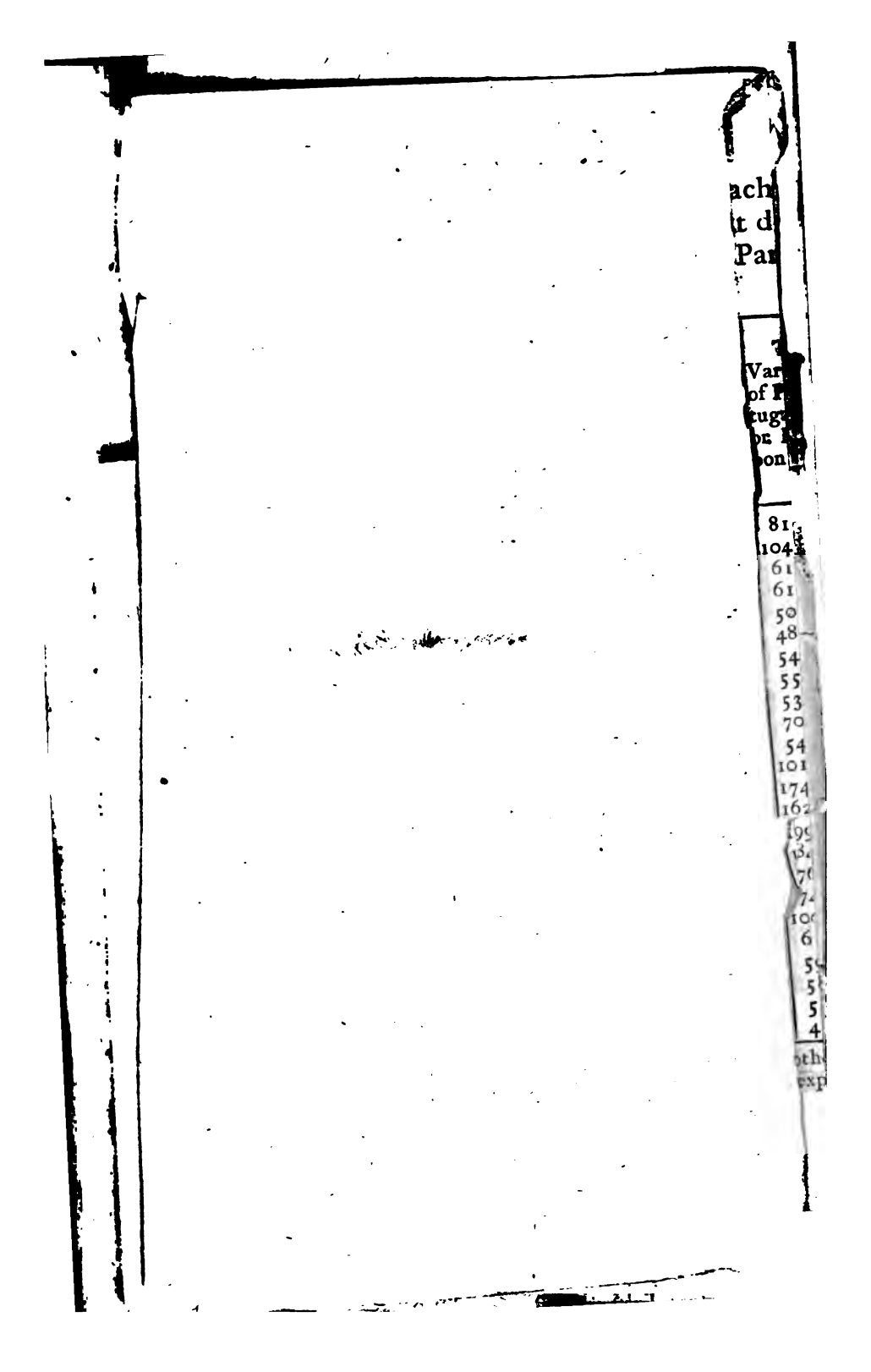
I shall conclude this extraordinary and useful subject, with extract from the merchant's public counting-house, the thor of which seems to have understood well the extent and licacy of this rule. "Whoever," says he, "trades as a merchant, that is to say, as an exporter and importer in Europe, must of necessity have to do with drawing and remitting; and if so, he should by no means be unacquainted with those arts of making the best advantages by so doing; but this is not possible to be done, without being thoroughly skilled in their arbitration to a demonstrative exactitude. —— The more general the trade of a merchant is, the more universal should his knowledge be in this particular; and those who may have views of dealing largely by exchange, will certainly find their account beyond expectation, in being fundamentally grounded in this extraordinary subject: for a trader of a good general foreign correspondence, may by this means gain more by dint of credit and skill, than others unacquainted herewith can do by dint of hard money."

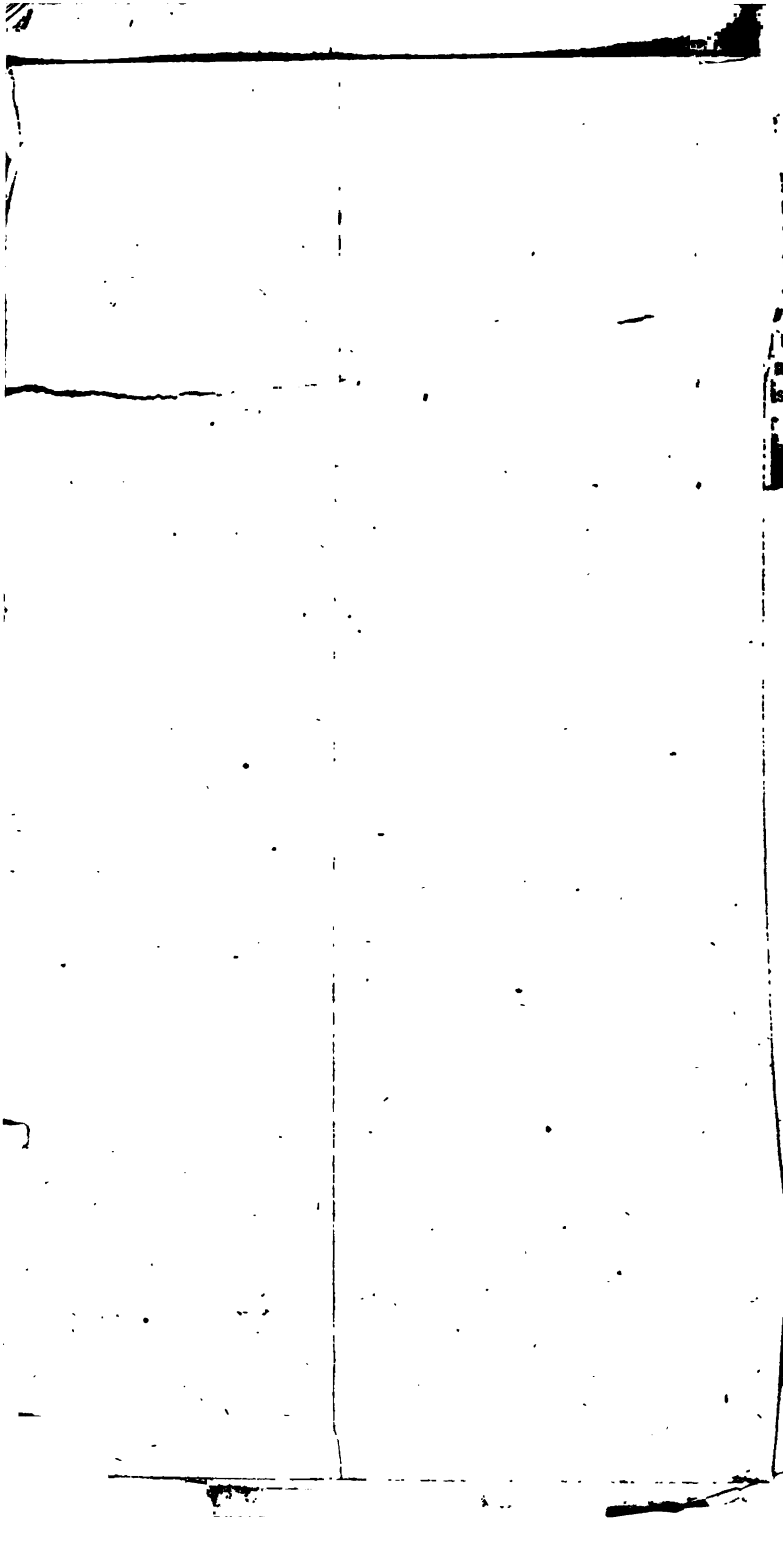
ariety XIII. Comparison of Weights and Measures.

AS it is of the utmost importance for the extensive trader, not only to be acquainted with the weights and measures the different countries with which he may have occasion to al, but with their relation one to another; I have in the first rt of this work exhibited authentic tables of all the weights d measures of those countries with which we deal, and eir subdivisions, as well as the weights and measures used Britain; and I shall now insert two tables, representing the nformity which the weights and measures of the most noted ading places of Europe have with one another, discoverable inspection, and then give a few examples of their compason, by the rule of conjunct proportion, after the manner compound arbitration.

[*The tables follow, to be folded in.*]

Examples





A TABLE represen
from that of Mynheer
by the Sieur Jean Lau
of the columns, in o
vinces, and the Sieur L

☞ As the weight of Amst
Bensançon, and several other p
fling difference, they are com
Amsterdam, as those of Nure
fort, and others in the same m

A	100 lb. of England, Scotlad, a
B	100 lb. of Amsterdam, Paris, &c
C	100 lb. of Antwerp, or Brabant
D	100 lb. of Roüen, the visounty
E	100 lb. of Lyons, the city
F	100 lb. of Rochelle
G	100 lb. of Toulouse, and Upper L
H	100 lb. of Marseilles and Provence
I	100 lb. of Geneva
K	100 lb. of Humburg
L	100 lb. of Frankfort
M	100 lb. of Leipsic
N	100 lb. of Genoa
O	100 lb. of Leghorn
P	100 lb. of Milan
Q	100 lb. of Venice
R	100 lb. of Naples
S	100 lb. of Seville, Cadi
T	100 lb. of Lyons?
V	

— g abridged, we will have

Macon to replace 100 at Lyons.

ppose 100 lb. of Amsterdam weigh 100 lb.
o lb. of Paris, 150 of Genoa, 100 lb. of Genoa,
eipsic; 100 lb. of Leipsic, 160 lb. in Milan; how
of Milan will 548 lb. of Amsterdam weigh?

The

Examples of the comparison of weights and measures.

Exam. 1. If 7 aunes of Paris make 9 yards of London, 36 yards of London 49 aunes of Holland, 7 aunes of Holland 9 braces of Milan, 3 braces of Milan 7 vares of Arragon, 5 vares of Arragon 2 canes of Montpelier, 9 canes of Montpelier 10 canes of Thoulouse, and 4 canes of Thoulouse 9 aunes of Troyes in Champaigne: how many aunes of Troyes will measure 100 aunes of Paris?

Antecedents.		Consequents.
7 aunes of Paris	=	9 yards of London.
36 yards of London	=	49 aunes of Holland.
7 aunes of Holland	=	9 braces of Milan.
3 braces of Milan	=	2 vares of Arragon.
5 vares of Arragon	=	2 canes of Montpelier.
9 canes of Montpelier	=	10 canes of Thoulouse.
4 canes of Thoulouse	=	9 aunes of Troyes.
How many aunes of Troyes	=	100 aunes of Paris?

Both sides of the equation being abridged, the operation will stand,

$$\frac{3\times100}{2} = 150 \text{ aunes of Paris.}$$ *Answer.*

Exam. 2. Suppose you owe 100 anees of wheat at Lyons, and would know what quantity you would purchase at Macon to replace them, and have no other mean of knowledge but the following, *viz.*

3 anees of Lyons	=	4 setier of Paris.
1 setier of Paris	=	2 bushels of Bourdeaux.
36 bushels of Bourdeaux	=	27 muds of Amsterdam.
27 muds of Amsterdam	=	46 fanegas of Cadiz.
230 fanegas of Cadiz	=	57 anees of Macon.
How many of Macon	=	100 of Lyons?

Both sides of the equation being abridged, we will have

$$\frac{46\times2\times100}{115} = 80 \text{ anees of Macon to replace 100 at Lyons.}$$

Exam. 3. Suppose 100 lb. of Amsterdam weigh 100 lb. of Paris; 100 lb. of Paris, 150 of Genoa, 100 lb. of Genoa, 70 lb. of Leipsic; 100 lb. of Leipsic, 160 lb. in Milan; how many lb. of Milan will 548 lb. of Amsterdam weigh?

The

The terms in this example being equated and abridged, it will be

$$\frac{3\times8\times7\times528}{5\times5} = 920\tfrac{16}{25} \text{ of Milan} = 548 \text{ lb. of Amſterdam.}$$

Exam. 4. Suppoſe a merchant of Hamburg, not knowing the proportion between the ell of that place and yard of London, and having orders to procure 81 yards of cloth, of which 7 ells of Hamburg muſt be had for 3 *l. Sterling*; how ſhall he diſcover how many pounds Sterling the 81 yards will amount to, only by knowing that 7 ells of France make 9 yards of London, and 7 ells of Holland make 4 ells of France, and that 1 ell of Holland makes $1\frac{1}{7}$ of Hamburg?

Note, ſince $1 = 1\frac{1}{7}$, conſequently 5=6, which diſpatches the fraction.

9 yards of London	=	7 ells of France.
4 ells of France	=	7 ells of Holland.
5 ditto of Holland	=	6 ditto of Hamburg.
7 ditto of Hamburg	=	3 *l. Sterling.*
How much Sterling for		81 yards?

Both ſides of the equation being abridged, it will be

$$\frac{9\times7\times3\times3}{2\times5} = L.\ 56\ 14s.\ \textit{Anſwer.}$$

Variety XIV. INTEREST.

INTRODUCTION.

INtereſt of money is an allowance made by the borrower to the lender for the uſe of money, at a certain rate *per cent. per annum*; which may be under the rate eſtabliſhed by law, if it is ſo ſtipulated betwixt the parties, but never can be above it, without incurring a ſevere penalty on the part of the lender.

After the Jews were baniſhed, there were, from time to time, many laws and ordinances made in this kingdom, as well by the church as ſtate, againſt uſury; but all to little purpoſe: for perſons who wanted money, and were willing to give extraordinary intereſt, were never at a loſs to be ſup-

plied, provided they were men of credit, or could find good ſecurity. Wherefore, as the practice could not be prevented, the parliament, *anno* 37 *Hen.* VIII. *cap.* 9. made an act to prohibit the taking more than 10 *per cent.* under very ſevere penalties. This act commenced the 31ſt of January 1545, and is the firſt wherein any rate of intereſt is mentioned. In this act uſury is declared to be unlawful.

In leſs than ſeven years, *anno* 5 *Ed.* VI. *c.* 20. this act was repealed, and every gratuity whatever forbid for the uſe of money, under ſevere penalties.

Anno 13 *Eliſ. c.* 8. this ſtatute of Edward was repealed, and that of Henry VIII. with ſome additional clauſes, revived.

Anno 21 *Jac.* I. *c.* 17. it was made penal to take above 8 *per cent.*

Anno 12 *Car.* II. *c.* 13. it was made penal to take above 6 *per cent.*: and *anno* 12 *Annæ*, *c.* 16. the intereſt of money was reduced to 5 *per cent.* from the 29th of September 1714, and this ſtatute continues in force to this day.

SECT. 1. *Simple Intereſt.*

Simple intereſt is that which is paid for the loan of any principal or ſum of money lent out for ſome time at any rate *per cent.* agreed on betwixt the borrower and the lender, which, according to 12 *Annæ*, *ſeſſ.* 2. *c.* 6. no perſon is to take for the loan of monies, *&c.* above 5 *l.* for the forbearance of 100 *l.* for the ſpace of a year; and bonds, contracts, *&c.* made for money let at a greater intereſt, to be void and null, and the offender to forfeit triple value.

Caſe 1. The principal rate and time given, to find the intereſt.

RULE.

Multiply the principal by the rate, and that product by the time, the laſt product divided by 100 quotes the anſwer.

EXAMPLES.

Exam. 1. What is the intereſt of *L.* 426 : 5 : 9 for $6\frac{1}{4}$ years, at $4\frac{1}{2}$ *per cent.*?

426.2875
$4\frac{1}{4}$
1705.1500
213.14375
1918.29375
$6\frac{3}{4}$
8) 11509.76250
1438.7203125
100) 129.484828125=*L.* 129-9-$8\frac{1}{4}$

Or thus,
426.2875
.045
21314375
17051500
191829375
$6\frac{3}{4}$
8) 115.0976250
14.3872031
129.4848281 = 129*l.* [9*s.* $8\frac{1}{4}$*d.*

It would have been the ſame thing, though all the decimal places had been ſaved in the operation, but three places next the point; as any thing below the common ſubdiviſions of a pound cannot be reckoned in intereſt, as there is no ſpecie ſmall enough to be offered in payment, and the leaſt fraction extraordinary is uſury.

The rationale of this, and all the other caſes of ſimple intereſt, is deduced from compound or univerſal proportion: for

L. pr. year. L. in. L. prin. years.
100 : 1 :: $4\frac{1}{4}$: 427.2875 : $6\frac{3}{4}$: *L.* 129 : 9 : $8\frac{1}{4}$.

And the firſt and laſt method is the ſame; for it makes no difference to multiply by $4\frac{1}{4}$ and divide by 100, and to multiply by .045 without any diviſion.

CONTRACTIONS.

The intereſt of any ſum for one year may be found practically as commiſſion, which may be afterwards multiplied into any number of given years, and divided for any aliquot parts of a year.

The laſt example reſumed,
20) 426.2875
10) 21.3144 at 5 *per cent.*
2.1314 at $\frac{1}{4}$ being $\frac{1}{16}$ of 5 *per cent.*
(carried forward) 19.1830 at $4\frac{1}{4}$ *per cent.* for 1 year.

19.1830 at $4\frac{1}{2}$ *per cent.* for 1 year.
$6\frac{1}{4}$

8) 115.098 for 6 years
14.387

129.485 as before.

Or thus.

5) 426.2875

2) 85.2575 at 20 *per cent.*
42.6287 at 10 *per cent.*

80) 127.8862 at 30 *per cent.*
1.5973 at $\frac{1}{8}$ *per cent.*

129.4835 at $30\frac{1}{8}=4\frac{1}{2}\times 6\frac{1}{4}$.

Exam. 2. What is the intereſt of *L.* 575, 15 *s.* for $5\frac{1}{4}$ years, at 5 *per cent.*?

4) 575 15

143 18 9 at 25 *per cent.*=5 *per cent.*×5 years.
14 7 $10\frac{1}{2}$ for $\frac{1}{4}$ year by dividing the principal by 40.
7 3 $11\frac{1}{4}$ for $\frac{1}{4}$ or $\frac{1}{2}$ of $\frac{1}{2}$ year.

L. 165 10 $6\frac{3}{4}=5\frac{3}{7}$ at 5 *per cent.*

Exam. 3. What is the intereſt of *L.* 478, 10 *s.* for $3\frac{1}{7}$ years, at 6 *per cent. per annum.*?

6 10) 478.5
$3\frac{1}{7}$

$19\frac{1}{7}$ 2) 47.85 for 10 *per cent.*
23.925 for 5 *per cent.*
9.57 for 2 *per cent.* $\frac{1}{5}$ of $\frac{2}{10}$
9.57 for 2 *per cent.* ditto.
.957 for $\frac{1}{7}=\frac{1}{10}$ of 2 *per cent.*

91.872 for $19\frac{1}{7}=6$ *per cent.* of $3\frac{1}{7}$ years.

It is not accurate in the calculation of intereſt to take aliquot parts for months, becauſe the year is not divided into months, conſiſting each of the ſame number of days; and it happens more frequently in buſineſs, that one hath occaſion to calculate intereſt for days than for any fixed ſpace of time: wherefore, to find the intereſt of any ſum for any number of

days leſs than a year, multiply the given ſum by the number of days, and divide the product by 7300, the quotient will give the intereſt at 5 *per cent.* which is the legal rate; but if the intereſt at a higher or lower rate is required, take parts of the quotient for the difference, and add or ſubtract accordingly.

Exam. 4. What is the intereſt of *L.* 547, 15 *s.* at 5 *per cent.* for 320 days?

547·75
320
109550
164325
7300) 1752.8000 (24.0109=*L.* 24·0·2$\frac{1}{4}$
146
292
292
80
73
700
657
(43)

The reaſon of this operation is deduced from the ſame principles with the foregoing:

L. *days.* *L.* *L.* *days.*
For 100 : 365 :: 5 : 547·75 : 320 : *L.* 24.0109.
73 1

Hence it is plain, that as the ſecond and third terms remain always the ſame, they will always admit of the ſame abbreviation; and therefore when the principal is multiplied into the days, and that product divided by 100×73, it will have the ſame effect as if the work was carried on at length. As caſes of this kind are more frequent than any other, I would adviſe the young arithmetician to get the product of 73 into all the nine digits by heart, that he may as readily divide any number by it, as by a ſingle digit.

Exam. 5. What is the intereſt of *L.* 248, 19 *s.* for 175 days at 4 *per cent?*

248.95

248.95
175

124475
423215

7300) 435.6625

5) 5.9679 at 5 *per cent.*
1.1935 at 1 *per cent.*

4 7744 at 4 *per cent.*=*L.* 4·15·5¾.

Exam. 6. What is the intereſt of *L.* 150 from the 18th day of January to the 11th of November, at 4¼ *per cent.*?

	Days
January	13
February	28
March	31
April	30
May	31
June	30
July	31
Auguſt	31
September	30
October	31
November	11
	297

150
297

73) 445.50

20) 6.102 at 5 *per cent.*
305 at ¼ *per cent.*

5.797=*L.* 5·15·11, at 4¼ *per cent.*

Exam. 7. What is the intereſt of *L.* 384, 16 *s.* from the 7th of May to the 11th of December, at 5½ *per cent.*?

384.8
210

7696

73) 842.712

11.544=*L.* 11·10·10½.

When intereſt is to be calculated on caſh-accounts, accounts-current, or any other accounts where partial payments are made, or partial debts contracted, multiply the ſeveral balances into the days they are at intereſt, and the ſum of theſe products, divided by 7300, will quote the intereſt at 5 *per cent.*: for any other rate make the proper addition or deduction as before. The whole operation ought to ſtand as in the following examples.

Exam.

Exam. 8. On the 1st of May, I lent Ralph Newlands *per* bill at one day's date, L. 500; which I received back in the following partial payments, *viz.* on the 13th May, *L.* 50; on the 4th June, *L.* 56; on the 14th July, *L.* 44; on the 23d ditto, *L.* 50; on the 18th Auguſt, *L.* 87; on the 30th ditto, *L.* 13; on the 21ſt September, *L.* 30; on the 18th October, *L.* 30; on the 29th ditto, *L.* 40; on the 11th November, *L.* 50; and on the 28th December, *L.* 50: what intereſt is due at 5 *per cent.*?

Dates.		*Caſh tranſactions with Ralph Newlands.*	*exten.*	*days.*	*pro.*
May	1	Lent *per* bill at one day's date - -	500	13	6500
	13	Received in part - - -	50		
		Bal.	450	22	9900
June	4	Received in part - - -	56		
		Bal.	394	40	15760
July	14	Received in part - - -	44		
		Bal.	350	9	3150
	23	Received in part - - -	50		
		Bal.	300	26	7800
Aug.	18	Received in part - - -	87		
		Bal.	213	12	2556
	30	Received in part - - -	13		
		Bal.	200	2	4400
Sept.	21	Received in part - - -	30		
		Bal.	170	27	4590
Oct.	18	Received in part - - -	30		
		Bal.	140	11	1540
	29	Received in part - - -	40		
		Bal.	100	13	1300
Nov.	11	Received in part. - - -	50		
		Bal.	50	47	2350
Dec.	28	Received in full of principal - -	0		59846

73) 598.46

8 3 11$\frac{5}{73}$ intereſt on the above account.

Exam. 9. Lent John Jameſon *per* bill, dated 18th January, payable one day after date, *L.* 878:19. 10 $\frac{1}{2}$. which I received back in the following partial payments, *viz.* on the 27th February, *L.* 57:15:7; on the 18th March, *l.* 37, 14*s.*; on the 29th April, *L.* 34, 11*s.*; on the 12th May, *L.* 136, 15*s.*

15 *s.* 7 *d.*; on the 19th June, *L.* 67 : 13 : 4; on the 15th July, *L.* 15 : 15 : 6; on the 25th ditto, *L.* 111 : 11 : 11; on the 3d October, *L.* 78 : 7 : 4; on the 19th November, *L.* 100; on the 23d ditto, *L.* 100; and on the 30th December received the balance of the principal: how much intereſt ought I to claim at 5 *per cent.*?

Caſh-tranſactions with John Jameſon.

Dates.				*Extended.*	*Days.*	*Products.*
Jan.	18	Lt *p.* bill at one day's date		878 19 10	40	35159 13 4
Feb.	27	Received in part		57 15 7		
			Bal.	821 4 3	19	15603 0 9
March	18	Received in part -	-	37 14		
			Bal.	783 10 3	42	32907 10 6
April	29	Received in part -		34 11		
			Bal.	748 19 3	13	9736 10 3
May	12	Received in part -	-	136 15 7		
			Bal.	612 3 8	38	23262 19 4
June	19	Received in part -	-	67 13 4		
			Bal.	544 10 4	26	14157 8 8
July	15	Received in part -	-	15 15 6		
			Bal.	528 14 10	10	5287 8 4
Ditto	25	Received in part -	-	111 11 11		
			Bal.	417 2 11	7	29200 4 2
Oct.	3	Received in part -	-	78 7 4		
			Bal.	338 15 7	47	15922 12 5
Nov.	19	Received in part -	-	100		
			Bal.	238 15 7	4	955 2 4
Ditto	23	Received in part -	-	100		
			Bal.	138 15 7	37	5134 16 7
Dec.	30	Received in full of prin^{l}		138 15 7		
						187317 6 8

73) 1872.17 6 8

25 13 2 intereſt on the above account.

I have given Thomas Truman a caſh credit for *L.* 2000: in conſequence of which, on the 8th January, I paid his bill for *L.* 500; ditto 29th, paid his draught for *L.* 560; February 27th he gave me a bill on the new bank at ſight for *L.* 580; March 14th he paid me *per* receipt *L.* 140; April 29th he drew for *L.* 1500 at

at ſight; May 18th he paid me *per* my receipt *L.* 1000; June 29th he drew at ſight for *L.* 270, and 18th July for 350; September 19th he paid in *per* receipt *L.* 600, and October 18th *L* 250. November 11th he drew at ſight for *L.* 750, and ditto 13th for *L.* 250. December 12th he paid in *per* receipt *L.* 580, and 30th ditto *L.* 420. On the 8th January thereafter he demands a ſettlement: what principal and intereſt is he due to me for the year's tranſactions, intereſt at 5 *per cent.*?

Dates.		*Caſh-tranſactions with Thomas Truman.*		*Ex.*	*Days.*	*Pro.*
Jan	8	Paid his bill		590	50	25000
Ditto	29	Paid his draught		560	29	16240
			Bal.	1060		
Feb.	27	Received in part		580		
			Bal.	480	15	7200
March	14	Received in part		140		
			Bal.	340	46	15640
April	29	Paid		1500		
			Bal.	1840	19	34960
May	18	Received in part		1000		
			Bal.	840	42	35280
June	29	Paid		270		
			Bal.	1110	19	21090
July	18	Paid		350		
			Bal.	1460	63	91980
Sept.	19	Received in part		500		
			Bal.	960	29	27840
Oct.	18	Received in part		250		
			Bal.	710	24	17040
Nov.	11	Paid		750		
			Bal.	1460	2	2920
Ditto	13	Paid		250		
			Bal.	1710	29	49590
Dec.	12	Received in part		580		
			Bal.	1130	18	20340
Ditto	30	Received in part		420		
Jan.	8		Bal.	710	9	6390
						371510

Then 73) 3715.10

50 17 10 intereſt on the above account.
710 balance of the account.

760 17 10 total balance.

When caſh-credits are given in the banks, accounts are gegerally kept as in the preceding examples, and a balance made upon every tranſaction, which is multiplied into the days the firſt convenient minute; in which caſe, when the period of ſettling their accounts comes, they have only to add up the products, divide by 7300, and the account is finiſhed.

When partial payments are made upon bonds, bills, *&c.* at any interval greater than twelve months, the intereſt is calculated in a progreſſive manner, by adding the intereſt to the principal at the time of the firſt payment, and from that ſum deducting the payment, *&c.*; and this method hath the authority of the court of ſeſſion for its ſanction, in caſh accounts of various kinds; only the banks are not allowed, at leaſt do not take this privilege, becauſe their caſh-tranſactions are very frequent; and it amounts to the ſame thing, when they give no caſh-accounts but what muſt be ſettled once in twelve months.

Specimen of a progreſſive account.

Borrowed on bond, of date 21ſt May 1754, *L.* 1000. Paid back on the 18th July 1755, *L.* 350; on the 29th September 1756, *L.* 150; on the 19th December 1757, *L.* 180; on the 18th July 1758, *L.* 120; on the 18th September 1759, *L.* 50; and on the 21ſt May 1762, I paid up the balance of the principal; how much more had I to pay to retire mybond, intereſt at 5 *per cent.*?

1754. *May* 21	Borrowed on bond - -	1000		
	Intereſt for 1 year and 58 days -	57	18	$10\frac{3}{4}$
	Amount	1057	18	$10\frac{3}{4}$
1755. *July* 18	Paid in to account -	350		
	Balance	707	18	$10\frac{3}{4}$
	Intereſt for 1 year and 73 days	42	9	6
	Amount	750	8	$4\frac{3}{4}$
1756. *Sept.* 29	Paid in to account - -	150		
	Balance	600	8	$4\frac{3}{4}$
	Intereſt for 1 year and 81 days -	36	13	$7\frac{3}{4}$
	Amount	637	2	$0\frac{1}{2}$
1757. *Dec.* 19	Paid in to account -	180		
	Balance	457	2	$0\frac{1}{2}$
	Intereſt for 1 year and 211 days	36	1	4
	Amount	493	3	$4\frac{1}{2}$
1758. *July* 18	Paid in to account.	120		
	Balance	373	3	$4\frac{1}{2}$
	Intereſt for 1 year and 62 days	21	16	$6\frac{1}{2}$
	Amount	394	19	11
1759. *Sept.* 18	Paid in to account. -	50		
	Balance.	344	19	11
	Intereſt for 2 years and 245 days	46	1	$6\frac{1}{4}$
	Amount	391	1	$5\frac{1}{4}$
1762. *May* 21	Paid the balance of the principal	150		
	Balance due	241	1	$5\frac{1}{4}$

DISCOUNT.

Caſe 2. Amount, rate, and time given, to find the principal, or preſent worth.

RULE.

As the amount of *L.* 100 at the rate and time given is to *L.* 100, ſo is the given amount to the principal or preſent worth required.

Exam. 1. What ready money will pay a debt, due 3 years and

and 145 days hence, of *L.* 3998 : 12 : 10½, diſcounting intereſt at 3 *per cent. per annum?*

The time = 3.4

3 the intereſt of 100 *l.* for 1 year.

10.2 } the intereſt
Add 100 } of 100 for the given time.
110.2 } the amount

Then *L.* 110.2 : 100 :: 3998.6427

100

110.2)399864.270000(3998.6427 amount.
3628.53239 prin.
370.11031 diſc.

3306
6926
6612
3144
2204
9402
8816
5867
5510
3570
3306
2640
2204
4360
3306
10540
9918
622

Or it will be the ſame thing to work as follows:

3.4
.03 intereſt of *L.* 1 for 1 year.

1.102 amount of ditto for 1 year.

Then 1.102 : 1 :: 3998.6427 : 3628.53239 as before.

Exam. 2. What ready money will diſcount a bill payable 6 months hence of *L.* 500, intereſt at 5 *per cent.*?

.05
5

1.025) 500.000
.05 100.000
.041) 20.000

L. 487 16 1$\frac{1}{2}$ *Anſwer.*

Bankers and others who diſcount bills never uſe the above method, becauſe in that caſe they would have no more than the intereſt of the money they pay down, which they reckon too ſmall a conſideration for keeping clerks and ready money by them for the purpoſes of diſcounting; and therefore they not only deduce intereſt from the contents of the bill for the time it hath to run, with three days of grace, but likewiſe very often charge commiſſion. It is a common practice among petty bankers to lend a man money by diſcounting his own bill, and taking commiſſion at $\frac{1}{4}$, $\frac{1}{2}$, and ſometimes more for 3 months; when that time is elapſed, and the acceptor of the bill cannot conveniently pay, out of mere lenity, the bill is renewed for three months longer, and diſcounted upon an extraordinary commiſſion, and the practice is continued for a mighty favour till the man's eyes are opened, with paying at the rate of 10 *per cent.* for the uſe of his money. There are others who go ſtill more neatly to work in taking advantage of the neceſſitous. ——The man who wants money offers his own acceptance at a ſhort date to ſale.——If the bill is for *L.* 100, the monied man perhaps offers him *L* 80, more or leſs, as he can make his bargain, or as he underſtands the acceptor's credit depends on having the money.——This method needs little calculation. For the former take the following examples.

Exam. 1. A bill of *L.* 500 is to be diſcounted 120 days, to run intereſt at 5 *per cent.*; how much money will the holder receive?

500
120

73) 600.00

8 4 4$\frac{1}{2}$ deducted from *L.* 500.

491 15 7$\frac{1}{2}$ *Anſwer.*

Exam.

Exam. 2. A bill of *L.* 449, 18 *s.* is to be diſcounted, 180 days to run, intereſt at 5 *per cent.* upon allowing commiſſion at $\frac{1}{2}$ *per cent.*; what money does the holder receive?

449.9
180

73) 809.820

11.093 intereſt.
2.2495

13.3425

436.5575=*L.* 436 11 2

200) 449.9

2.2495

Exam. 3. A bill dated May 8. payable September 15. preſented June 10. for diſcount, was diſcounted by deducting intereſt at 5 *per cent.* commiſſion $\frac{1}{2}$; what will the holder receive, the contents being *L.* 378, 16 *s.*?

378.8
97 days to run.

26516
34092

73) 367.436

5.0333
.947

5.9803=*L.* 5 19 7

4|00) 3|78.8(
.947

Caſe 3. The amount, principal, and time given to find the rate of intereſt.

RULE.

As the principal multiplied by the time is to the whole intereſt, ſo is *L.* 100 to the rate *per cent.*

At what rate of intereſt will *L.* 500 become *L.* 537, 10 *s.* in 1 year and 6 month?

```
      500                                  537 10
      1.5                                  500
   ------                                 ------
5) 750.0 : 37.5 :: 100                    37. 10
   ------
5) 150      7.5      50
 2) 30      1.5      1.5
    15                ----
                 15) 750
                     ----
                     5 per cent.
```

Case 4. The principal, amount, and rate of the interest being given, to find the time.

As the interest of the principal of 1 year, at the given rate, is to 1 year, so is the whole interest to the time required.

Exam. In what time will *L.* 500 become *L.* 537, 10*s.* at 5 *per cent. per annum?*

```
5) 25 : 1 :: 37.5
                1
             ----
         5) 37.5
             ----
         5) 7.5
            1.5=1 year and 6 months.
```

Practical Questions.

Quest. 1. I have a bond from the bank for *L.* 500 at 4 *per cent.* —Ditto with the tannery company for *L.* 500 at 5 *per cent.* 300 3½ *per cent.* annuities, and 500 3 *per cent.* annuities; what may I afford to live at *per annum*, without breaking my stock.

L. 500 at 4 *per cent.* - - -	*L.* 20	
500 at 5 *per cent.* - - - -	25	
300 annuities at 3 ½ *per cent.* -	10	10
500 annuities at 3 *per cent.* -	15	
1800	70	10

Quest. 2. Being straitened, I discounted my own bill with J.D. for *L.* 500, dated the 1st January, payable in 2 months thereafter, allowing commission at ½ *per cent.* and deducting interest

intereſt at 5 *per cent.*—I was obliged to repeat the tranſaction ſix different times for that year, and paid the laſt bill when it fell due: at what rate of intereſt had I my money?

500 for which the bill was granted.

4 3 4 intereſt for 2 months.
2 10 commiſſion.

6 13 4 charges in all.

493 6 8 received.

Then 500 : 6 13 4×6 :: 100
6

5) 40

8 *per cent.* which is too much for any trade to ſupport.

But ſtill more if we conſider that the diſcounting of theſe bills will coſt *L.* 6 : 13 : 4 ready money every time, excepting the firſt, which will raiſe the intereſt conſiderably higher.

Queſt. 3. Sold my own acceptance of *L.* 100 payable 3 months after date, for *L.* 80 ready money; at what rate of intereſt did I procure the money?

80
.25

20.00 : 20 :: 100 : 100 *per cent.*

For $\frac{100\times 2}{2}=100$

This is truly barbarous, and yet it is practiſed. Such methods of eluding the law cannot be too ſeverely puniſhed, or too cautiouſly guarded againſt ——It would be much better for a man, who finds he cannot pay his creditors if a little time is granted him, to throw himſelf upon their mercy, than give away his ſubject voluntarily to ſuch mercileſs uſurers; nor is it to be imagined, that his creditor would uſe him ſo unaccountably ill.

TABLE

TABLE of Days for any Time.

Days.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
1	1	32	60	91	121	152	182	213	244	274	305	335
2	2	33	61	92	122	153	183	214	245	275	306	336
3	3	34	62	93	123	154	184	215	246	276	307	337
4	4	35	63	94	124	155	185	216	247	277	308	338
5	5	36	64	95	125	156	186	217	248	278	309	339
6	6	37	65	96	126	157	187	218	249	279	310	340
7	7	38	66	97	127	158	188	219	250	280	311	341
8	8	39	67	98	128	159	189	220	251	281	312	342
9	9	40	68	99	129	160	190	221	252	282	313	343
10	10	41	69	100	130	161	191	222	253	283	314	344
11	11	42	70	101	131	162	192	223	254	284	315	345
12	12	43	71	102	132	163	193	224	255	285	316	346
13	13	44	72	103	133	164	194	225	256	286	317	347
14	14	45	73	104	134	165	195	226	257	287	318	348
15	15	46	74	105	135	166	196	227	258	288	319	349
16	16	47	75	106	136	167	197	228	259	289	320	350
17	17	48	76	107	137	168	198	229	260	290	321	351
18	18	49	77	108	138	169	199	230	261	291	322	352
19	19	50	78	109	139	170	200	231	262	292	323	353
20	20	51	79	110	140	171	201	232	263	293	324	354
21	21	52	80	111	141	172	202	233	264	294	325	355
22	22	53	81	112	142	173	203	234	265	295	326	356
23	23	54	82	113	143	174	204	235	266	296	327	357
24	24	55	83	114	144	175	205	236	267	297	328	358
25	25	56	84	115	145	176	206	237	268	298	329	359
26	26	57	85	116	146	177	207	238	269	299	330	360
27	27	58	86	117	147	178	208	239	270	300	331	361
28	28	59	87	118	148	179	209	240	271	301	332	362
29	29		88	119	149	180	210	241	272	302	333	363
30	30		89	120	150	181	211	242	273	303	334	364
31	31		90		151		212	243		304		365

Use of the foregoing table.

Prob. 1. To discover the number of days from the end of the year, to an assigned day in any month throughout the following year.

This is at once diſcoverable by inſpection; for inſtance, from 31ſt December to July 8.; under July and on a parallel with 8 we find 189 days, the number required.

Prob. 2. To diſcover the number of days betwixt an aſſigned day in any month to the end of the year.

This is found by a ſingle ſubtraction. For inſtance, from July 8.

The days in a year -	365
Under July, and on a parallel with 8 -	189
Remain -	176 days. *Anſ.*

Prob. 3. To find the number of days betwixt two aſſigned days in different months of the ſame year.

This is likewiſe effected by ſubtraction.——*E. G.* Required how many days betwixt 11th May and November 18. ?

From the number below November, and oppoſite to 18, *viz.* - - - - - - -	322
Subtract that under May and oppoſite to 11, *viz.*	131
Remain	191 days

Prob. 4. To find the number of days betwixt an aſſigned day in any month of one year, to an aſſigned day of any month in the next year.

To the days to run in the year diſcoverable by *Prob.* 2. add the days to the next aſſigned period by *Prob.* 2. and the ſum is the anſwer.

Note. When leap-year is in the queſtion, and the month of February betwixt the aſſigned periods, 1 muſt be added to the reckoning, as the table goes no further than 28 for February.

A TABLE OF SIMPLE INTEREST.

The intereſt of one pound for any number of days, &c.

Days	3 per cent,	3½ per cent.	4 per cent.	4½ per cent.	5 per cent.	Days
1	.0000,821	.0080,958	0001,095	.0001,232	.0001,369	1
2	.00 ..643	.0001,971	.0002,191	.0002,465	.0002,739	2
3	.0002,465	.0002,876	.0003,287	.0003,698	.0004,109	3
4	0003,287	.0003,835	.0004,383	.0004,931	.0005,479	4
5	0004,109	.0 04,794	.0005,479	.0006,164	0006,849	5
6	0004,931	0005,753	.0006.575	.00 7,397	.0008,219	6
7	0005,753	.0006,7.2	.0007,671	.0008,630	0009,589	7
8	.0006 575	.0007,671	0008,-67	.0009,863	.0010,958	8
9	0007,397	.0008.630	.0009.863	.0011.095	.0012,328	9
10	0008,219	.0009,589	.0010.958	.0012,328	.0013,698	10
11	0009,041	.0010 547	.0012,054	.0013 561	.0015,068	11
12	.009,863	.0011,506	.0013,150	.0014,794	.0016,438	12
13	.0010.684	.0012,465	.0014,246	.0016,027	.0017,808	13
14	0011,506	.0013,424	.0015.342	.0017,260	.0019,178	14
15	0012 328	.0014,383	.0016,438	0018,493	0020.547	15
16	.0013,150	.0015,342	.0017,534	.0019,726	.0021,917	16
17	.01 j.972	.0016,301	.0018,630	.0020,958	.0023,287	17
18	0014,794	.0017,260	.0019.726	.0022,191	.0024.657	18
19	.0015,616	.0018,219	.0020,821	.0023,424	.0026,027	19
20	.0016,438	.0019,178	.0021,917	0024,657	.0027,397	20
21	.0017,260	.0020,137	.0023,013	.0025,890	.0028,767	21
22	.0018,082	.0021.095	.0024,109	.0027,123	.0031,137	22
23	.0018,904	.0022,054	.0025 205	.0028,356	.0031,506	23
24	0019.726	.0023,013	.0026,301	.0029,589	.0032,876	24
25	.0020,547	.0023,972	.0027,397	.0030,821	.0034,246	25
26	0021.369	.0024.931	.0028,493	0032,054	.0035,016	26
27	.0022,191	.0025,890	.0029 589	.0033,287	.0036.986	27
28	.0023,013	.0026,849	.0030,684	.0034,520	.0038,356	28
29	002 ,835	.0027,808	0031.780	0035,753	.0039,726	29
30	.0024.657	.0028,767	.0032,876	.0037.986	.0041,095	30
31	0025,479	.0029,726	.0033.972	0038,219	.0042,465	31
32	.0026,301	.0030.684	.0035.068	.0039,452	.0043,835	32
33	0027,123	.0031,643	.0036,164	.0046,684	.0045,205	33
34	.0027,945	.0032,602	.0037 260	.0041.917	.0046,575	34
35	.0028,767	.0033,561	.0038.356	.0043,150	.0047,945	35
36	.0029.589	.0034,520	.0039,452	.0 44,383	.0049,315	36
37	.0030,411	0035.479	.0040,54	0045,616	.0050,684	37
38	.0 31,232	.0036,438	.0041,643	.0046,849	.0052,054	38
39	.0032,054	.0037.397	.0042,739	0048.082	.0053,424	39
40	.0032,876	.0038,336	.0043,835	.0049.315	.0054,794	40

Days	3 per cent.	3 ½ per cent	4 per cent.	4 ½ per cent.	5 per cent.	Days
41	.0033.698	.0039,315	.0044,031	.0050,547	.0056.164	41
42	.0034,520	0040,274	.0046 027	.0051,780	.0057,534	42
43	.0035,342	.0041,232	.0047,123	.0053,013	.0058.9 4	43
44	.0036,164	.0042,191	.0048.219	.0054.246	.0060,274	44
45	.0036 986	.0043,150	.0049.315	.0055.479	.0061,643	45
46	.0037,808	.0044,109	.0050,411	.0056,712	0063,013	46
47	.0038 630	. 045,068	.0051.506	.0057,945	.0064.383	47
48	.0039,452	.0046,027	0052,602	.0059,178	.0065,753	48
49	.0040,274	0046,986	.0053,698	.0060,411	.0067 123	49
50	.0041,095	.0047,945	.0054.794	.0061,643	.0068.493	50
51	.0041,917	0048 904	.0055 890	.0062,876	.0069,863	51
52	.0042,739	.0049 863	.0056,986	.8064.109	.0071,232	52
53	.0043,561	0050,821	.0058,082	.0065.342	.0072,602	53
54	.0044.383	.0051,780	.0059,178	.0 66.575	.0073,972	54
55	.0045,205	.0052.739	.0060,274	.0067,808	.0075.342	55
56	.0046.027	.0053 698	.0061,369	.0069,041	.0076,712	56
57	0046,849	.0 54 657	0062.465	.0070,274	.0078,082	57
58	.0047.671	.005 ,6.6	.0063.561	.0071,506	.0079,452	58
59	.0048 493	0056 575	0064,657	.0072,739	.0080,821	59
60	.0049,315	.0057.534	.0065.753	.0073.972	.0082. 191	60
61	.0050,137	.0 58,493	0066.849	.0075,205	.0083,561	61
62	0 50,959	.0059 452	.0067.945	.0076,438	.0084,931	62
63	.0051,780	.0060,411	0069 041	.0077,671	.0086,301	63
64	.0052,602	0061.366	0070,137	.0078.904	.0087.671	64
65	.0053,424	0062 328	.007 .232	.0080,137	.0089.041	65
66	.0054,246	0063 287	.0072.328	.0081,369	.0090,411	66
67	0055 068	0064.246	0073.424	.0082,602	.0091,780	67
68	0055 890	0065,205	.0074 520	.0083,835	.0093,150	68
69	.005 712	.0066 164	.0075.616	.0085.068	.0094.520	69
70	0 57 534	.0067,123	.0076 712	.0086 301	.0095.890	70
71	.0058 356	.0068 082	.0077,708	0087,534	.0097.260	71
72	0059,178	.0069.041	.0078,904	.0088,767	.0098,630	72
73	0060.0 0	.0070,000	0080,000	.0090,000	.0100,000	73
74	0060 821	.0070,958	.0081,095	.0091,232	.0101.369	74
75	0061 643	.0071 917	0082 191	.0092,465	.0102,739	75
76	.0062 465	.0072,876	.0083,287	.0093.698	.0104,109	76
77	0063,287	0073,835	.0084,383	.0094 931	.0105,479	77
78	0064.109	0074,794	0085 479	.0096,164	.0106 849	78
79	.0064,931	0075.753	.0086 575	.0097 397	.0108 219	79
80	.0065,753	.0076,712	.0087,671	.0098,630	.0109,589	80

Days	3 per cent.	3 ½ per cent.	4 per cent.	4 ½ per cent.	5 per cent.	Days
81	.0066,575	.0077,671	.0088,767	.0099,863	.0110,958	81
82	.0067,397	.0078,630	.0089,863	.0101,095	.0112,328	82
83	.0068,219	.0079,589	.0090,958	.0102,328	.0113,698	83
84	.0069,041	.0080,547	.0092,054	.0103,561	.0115,068	84
85	.0069,863	.0081,506	.0093,150	.0104,794	.0116,438	85
86	.0070,684	.0082,465	.0054,246	.0106,027	.0117,808	86
87	.0071,506	.0083,424	.0095,342	.0107,260	.0119,178	87
88	.0072,328	.0084,383	.0096,438	.0108,493	.0120,547	88
89	.0073,150	.0085,342	.0097,534	.0109,726	.0121,917	89
90	.0073.972	.0086,301	.0098,630	.0110,958	.0123,287	90
91	.0074,794	.0087,260	.0099,726	.0112,191	.0124.657	91
92	.0075,616	.0088,219	.0100,821	.0113,424	.0126,027	92
93	.0076.438	.0089,178	.0102,917	.0114,657	.0127,397	93
94	.0077,260	.0090,137	.0103,013	.0115,890	.0128,767	94
95	.0078,082	.0091,095	.0104.109	.0117,123	.0130,137	95
96	.0078 904	.0092,054	.0105.205	.0118,356	.0131,506	96
97	.0079.726	.0093,013	.0106,301	.0119,589	.0132,876	97
98	.0080,547	.0093,972	.0107,397	.0120,821	.0134.246	98
99	.0081,369	.0094.931	.0108,493	.0122,054	.0135,616	99
100	.0082,191	.0095,890	.0109,589	.0123,287	.0136,986	100

Construction and use of the preceding table.

Daily interest is found by dividing the annual interest by 365: hence .05, the interest of *L.* 1 for 12 months at 5 *per cent.* divided by 365, the days in a year, quotes .0001369, the interest of *L.* 1 for one day; and, if this interest is multiplied by 2, the product will give the interest for 2 days, and so on continually, till a table for any number of days be constructed.

Hence will the use of the table be obvious: for suppose the interest of *L.* 478, 16 s. was required for 80 days, at 5 *per cent.*?

On a parellel with 80, and under 5 *per cent.* we find - .0109.589
Which multiplied by the given sum 478.8

Produceth the interest required - - *L.* 5 4 11¼

If the number of days given exceed the bounds of the table, the interest for ⅓, ½, ¼, may be found as above, and multiplied by 3, 2, 4, &c. accordingly. ——Had the last requisition been for 160 days, the interest would have been *L.* 5 4 11¼ × 2 = *L.* 10 9 10½.

But without the use of tables this might have been full as easy, when the interest is at *cent.* For instance.

478.8
80

73)383.040

L. 5 4 11¼ as before.

A TABLE of SIMPLE INTEREST.

The intereſt of one pound for a number of years.

Years.	At 3 per cent.	3 ½ per cent.	4 per cent.	4 ½ per cent.	5 per cent.	Years.
1	.03	.035	.04	.045	.05	1
2	.06	.07	.08	.09	.1	2
3	.09	.105	.12	.135	.15	3
4	.12	.14	.16	.18	.2	4
5	.15	.175	.2	.225	.25	5
6	.18	.21	.24	.27	.3	6
7	.21	.245	.28	.315	.35	7
8	.24	.28	.32	.36	.4	8
9	.27	.315	.36	.405	.45	9
10	.3	.35	.4	.45	.5	10
11	.33	.385	.44	.495	.55	11
12	.36	.42	.48	.54	.6	12
13	.39	.455	.52	.585	.65	13
14	.42	.49	.59	.63	.7	14
15	.45	.525	.6	.675	.75	15
16	.48	.56	.64	.72	.8	16
17	.51	.595	.68	.765	.85	17
18	.54	.63	.72	.81	.9	18
19	.57	.665	.76	.855	.95	19
20	.6	.7	.8	.9	.1	20
21	.63	.735	.84	.945	1.05	21
22	.66	.77	.88	.99	1.1	22
23	.69	.805	.92	1.035	1.15	23
24	.72	.84	.96	1.08	1.2	24
25	.75	.875	.1	1.125	1.25	25

This table is of uſe when intereſt is required for years and days together, which frequently occurs in paying off mortgages or bonds, as in progreſſive accounts; in this caſe, add the intereſt of *L.* 1 for the aſſigned years to the intereſt of *L.* 1 for the aſſigned days, and multiply by the ſum as before.

Compound

Compound Interest.

Compound interest is an allowance or gratuity made by the borrower to the lender, not only for the use of the principal, but likewise for the use of the interest, after it falls due; so that the interest being continually added to the principal, at the end of a year the sum or amount becomes a new principal for the succeeding year, and in this case the principal and interest are always increasing. It is true, the law doth not allow money to be put out at compound interest, but the interest may be exacted precisely when it is due, and lent out again, by which means all he purposes of compound interest may be answered to the lender; besides, in purchasing annuities, pensions, or leases in reversion, it is ordinary to allow the purchaser compound interest for his ready money, and therefore every dealer in these articles ought to understand it.

Case 1. Principal, rate, and time given, to find the interest.

To the principal add the interest for the first year, which becomes a new principal; to which add the interest thereof for another year, which becomes a principal at the end of the second year; proceed thus progressively for any number of years, and if there are days, add the interest of the last amount for that time, the difference betwixt the principal and this last amount gives the interest.

Or multiply the principal by the amount of *L.* 1 for a year continually for all the years proposed.

What is the compound interest of *L.* 500 for 3 years, at 5 *per cent.*?

20) 500	500
25	1.05 amount of 1 *l.*
20) 525 1st year.	525 1st year.
26.25	1.05
20) 551.25 2d year.	2625
27.5625	525
Amount 578.8125 3d year.	551.25 2d year.
	1.05
Interest 78.8125 3d year.	Amount 578.8125 3d year.
	Interest 78.8125 3d year.

Quest.

Queſt. 2. What will *L.* 524, 12 *s.* amount to in $3\frac{1}{2}$ years, compound intereſt being allowed at 4 *per cent.*?

524.6
.04

20.984 intereſt.

545.584 amount.
.04

21.82326 intereſt.

567.40736 amount.
.04

22.6963 intereſt.

50) 590.10366 amount at three years end.
11.80207 intereſt for 6 months.

601 90573 amount at the given period.

Caſe 2. The amount, rate, and time given, to find the principal or preſent worth.

RULE.

As the amount of *L.* 1 at compound intereſt, at the rate and for the time given, is to *L.* 1, ſo is the amount given to the preſent worth required.

Exam. What ready money will clear a debt due three years hence of *L.* 578 : 16 : 3, compound intereſt being allowed at 5 *per cent.*?

1.05
1.05

1.1025
1.05

1.157625 : 1 :: 578.812500 (500 *l. Anſwer.*
578.8125

.....

Caſe

Caſe 3. The principal, amount, and rate being given, to find the time.

RULE.

Divide the amount by the principal, and that quotient by the amount of *L.* 1 for a year, continually till unity is quoted; the number of diviſions gives the number of years.

Exam. In what time will *L.* 500 amount to *L.* 578:16:3, compound intereſt being allowed at 5 *per cent.*?

500) 578.8125

1.05) 1.157625 1

1.05) 1.1025 2

1.05) 1.05

Variety XV. Of purchaſing freehold or real eſtates.

ALL freehold or real eſtates, are ſuch as are bought to continue for ever; and queſtions relating to ſuch purchaſes, except in reverſion, may be done in the moſt ſimple manner, without having recourſe to the uſual theorems for performing queſtions of that kind.

Caſe 1. When the yearly income is required, it will be as 100 : the propoſed rate *per cent.* :: the ſum to be laid out in the purchaſe : the yearly income.

Exam. 1. A gentleman would lay out *L.* 1000 on the purchaſe of an eſtate, but in ſuch a manner as he might get $7\frac{1}{2}$ *per cent.* for his money, compound intereſt; what yearly income would he have from ſuch an eſtate?

100 : 7.5 :: 1000 : 75

For 1000
7·5

100) 75.000

Or 2|0) 100|0

2) 50
25

75 as before.

Exam. 2. A gentleman hath *L.* 3500 to lay out on the purchaſe of an eſtate, ſo as to have $4\frac{1}{2}$ *per cent. per annum* for his money; what would be his income?

2 3500

3500
4

8) 14000 = 4 *per cent.*
1750 = $\frac{1}{2}$

157.50 = *L.* 157 10 *s. per annum.*

Caſe 2. If the value of an eſtate is required, by having the yearly rent, and a certain allowance *per cent.* given; it will be as the rate *per cent.* : 100 :: the yearly rent : the value required.

Exam 1. There is an eſtate which yields nearly *L.* 75; what is the value in ready money, allowing intereſt at $7\frac{1}{2}$ *per cent.*?

7.5 : 100 :: 75 : 1000

For $\frac{100 \times 75}{7.5} = 1000.$

Exam. 2. An eſtate brings of yearly rent, *L.* 157, 10 *s.* what would it ſell for, allowing the purchaſer $4\frac{1}{2}$ *per cent.* for his money?

4.5 : 100 :: 157.5 : 3500

For $\frac{100 \times 157.5}{4.5} = 3500$ *Anſwer.*

Caſe 3. To find the rate *per cent.* on money laid out on the purchaſe of freehold eſtates. It will be, as the money laid out on the purchaſe is to the yearly rent, ſo is 100 to the rate *per cent.*

Exam. 1. Suppoſe *L.* 1000 is paid for a freehold eſtate, which yields of yearly rent *L.* 75; what rate of intereſt doth the purchaſer get for his money?

1000 : 75 :: 100 : 7.5

For $\frac{75 \times 100}{1000} = 7.5$ *Anſwer.*

Exam. 2 Suppoſe an eſtate of *L.* 150 *per annum* is ſold at 25 years purchaſe, how much per cent hath the purchaſer for his money?

25 × 150 = 3750 : 150 :: 100 : 4

Or 25 : 1 :: 100 : 4

Variety XVI. Of purchaſing freehold eſtates in reverſion.

Caſe 1. THE yearly rent of a freehold eſtate being known, to find the preſent worth of the reverſion of the ſaid eſtate, after the expiration of a certain number of years at any given rate *per cent.*; find the full value of the eſtate *per* laſt variety, and then find the principal that will raiſe that ſum, at the rate and time given, compound intereſt being allowed.

Suppoſe the reverſion of a freehold eſtate, of *L.* 50 yearly rent, to commence three years hence, is to be ſold immediately; what ready money ought to be paid for it, allowing the purchaſer 5 *per cent.* for his money?

Firſt 5 : 100 :: 50 : 1000
Then 1.05×1.05×1.05 : 1 :: 1000 : *L.* 863·19 *s.*

Caſe 2. The ſum given for the reverſion of a freehold eſtate, to commence after a certain number of years, being known, to find the yearly rent, allowing the purchaſer an aſſigned rate of intereſt for his money.

Find the amount of the ſum given, to the time from which the reverſion is to commence; and the yearly income which that amount will purchaſe, is the anſwer.

Suppoſe the reverſion of a freehold eſtate to commence three years hence, is ſold for *L.* 863, 19 *s.* allowing the purchaſer at the rate of 5 *per cent.* for his money; what ought the yearly rent to be in this caſe?

100 : 5 :: 1.05×1.05×1.05×863.95 : *L.* 50 *Anſwer.*

Conſtruction of decimal tables for computations in compound intereſt.

Operations by numbers in compound intereſt are generally attended with ſuch heavy multiplications and diviſions, that they become very troubleſome, and liable to errour; for which reaſon I have thought proper to inſert the following tables, by the help of which all queſtions relative to compound intereſt may be quickly reſolved, that fall within the compaſs of the tables. *Conſtruction*

Conſtruction of the firſt table.

The firſt table ſhows the amount of 1 *l.* from one year to forty, at 3, 3½, 4, 4½, and 5 *per cent.* and is effected by the continual multiplication of the amount of 1 *l.* for one year at theſe rates, *per* caſe 1. of compound intereſt. Thus the amount of 1 *l.* the third year at 5 *per cent.* will be

1.05×1.05×1.05=1.157625, and ſo of any other.

Conſtruction of the ſecond table.

The ſecond table ſhows the preſent worth or value of 1 *l.* payable at any period from one to forty years *incluſive*, and is effected by dividing 1 *l.* by the amount found in the firſt table for the time and rate aſſigned. Thus 1 being divided by 1.157625 will quote .8638376 for the preſent worth of 1 *l.* due three years hence, compound intereſt at 5 *per cent.*

Conſtruction of the third table.

The third table ſhews the amount of 1 *l. per annum*, and is eaſily made from the firſt table, thus: To 1 *l.* being the firſt year of the third table, add the 1ſt year of the firſt table, and the amount will be the ſecond year of the third table; to which add the ſecond year of the firſt table, and the amount will be the third year of the third table, *&c.* For inſtance,

To 1.000000
add 1.050000 the amount of 1 *l.* at 5 *per cent.* for 1 year.

2.050000 the amount for 2 years in the third table.
1.102500 ſecond year of the firſt table.

3.152500 third year of the third table, *&c.*

For the amount at the expiration of one year is the annuity itſelf, namely 1 *l.* and 1 *l.* being put out to intereſt at 5 *per cent.* will at the end of the year become 1.05 to which the annuity being added, the ſum 2.05 will be the amount of the annuity at the expiration of two years, as above.

Again, 2.05 *l.* the laſt amount, being let out to intereſt at the ſame rate for another year, it becomes at the expiration of that period 2.1525, to which adding 1 *l.* the annuity, we have 3.1525, which gives the third year of the third table, as before, *&c.*

Conſtruction of the fourth table.

The fourth table ſhews the preſent value of 1 *l. per annum*, &c. and is eaſily conſtructed by help of the ſecond. Thus, The preſent value of the firſt year in the ſecond table is the ſame in the fourth table; the firſt and ſecond years in the ſecond table, added together, make the ſecond year in the fourth table, and the third year in the ſecond table, added to the ſecond year in the fourth table, make the third year in the fourth. For inſtance, at 5 *per cent.*

The 1ſt year in 2d and 4th tables	= .9523809
The 2d year in the 2d table	= .9070294
The 2d year in the 4th table	= 1.8594104
The 3d year in the 2d table	= .8638376
The 3d year in the 3d table	= 2.7232480 *&c.*

For it is plain, that every number in the fourth table is the preſent worth or principal of that ſum or number in the third table which ſtands againſt the ſame years, and therefore the whole conſtruction depends upon the ſecond caſe of compound intereſt. Suppoſe the preſent worth of 2.05 *l.* the ſecond number in the third table, were required at 5 *per cent.* it would be $\frac{2.05}{1.1025}$=1.8594104. For as 1.1025 : 1 :: 2.05 : 1.8594104 *&c.*

Conſtruction of the fifth table.

The fifth table ſhews the annuity which 1 *l.* will purchaſe, *&c.* and is made in this manner. Find the preſent value of 1 *l.* per annum in the fourth table at the aſſigned rate and time; then divide unity by the preſent value ſo found, and the quotient will be the annuity which 1 *l.* will purchaſe at the ſame rate for the ſame time. For inſtance, ſuppoſe the annuity were required which 1 *l.* will purchaſe, to continue for three years, intereſt 5 *per cent.*

In the fourth table under 5 *per cent.* and oppoſite to three years, we have 2.7232480) 1.0000000

The 3d year in the 5th = .3672085 = the annuity for three years.

By the foregoing rules may the tables be continued to any number of years whatever.

TABLE

TABLE I.

Amount of 1 *l.* for years.

Years.	3 *per cent.*	3½ *per cent.*	4 *per cent.*	4½ *per cent.*	5 *per cent.*
1	1.0300000	1.0350000	1.0400000	1.0450000	1.0500000
2	1.0609000	1.0712250	1.0816000	1.0929501	1.1025000
3	1.0927270	1.1087178	1.1248640	1.1411661	1.1576250
4	1.1255088	1.1475230	1.1698586	1.1925186	1.2155063
5	1.1592740	1.1876863	1.2166529	1.2461819	1.2762816
6	1.1940523	1.2292553	1.2653190	1.3022601	1.3400956
7	1.2298738	1.2722792	1.3159318	1.3608618	1.4071004
8	1.2667700	1.3168090	1.3685691	1.4221006	1.4774554
9	1.3047731	1.3628973	1.4233118	1.4860951	1.5513282
10	1 3439163	1.4105987	1.4802443	1.5529094	1.6288946
11	1 3842338	1.4599697	1.5394541	1 6228530	1.7103393
12	1 4257608	1.5110686	1.6010322	1.6958814	1.7958563
13	1.4685337	1.5639560	1.6650735	1.7721961	1.8856491
14	1.5125897	1.6186945	1.7316764	1.8519449	1.9799316
15	1.5579674	1.6753488	1.8009435	1.9352824	2.0789282
16	1.6047064	1.7339860	1.8729812	2.0223701	2.1828746
17	1.6528476	1.7946755	1.9479005	2.1133768	2.2920183
18	1 7024336	1.8574892	2.0258165	2.2084787	2.4066192
19	1.7535060	1.9225013	2.1068492	2.3078603	2.5269502
20	1 8061112	1.9897888	2.1911231	2.4117140	2.65 ,2977
21	1.8602945	2.0594314	2.2787681	2.5202411	2.7859626
22	1.9161034	2.1315115	2.3699188	2.6336520	2.9252607
23	1.9735865	2.2061144	2.4647155	2.7521663	3.0715238
24	2.0327941	2.2833284	2.5633042	2.8760138	3.2251000
25	2.0937779	2.3632449	2 6658363	3.0054344	3.3863549
26	2.1565912	2.4459585	2.7724697	3.1406790	3.5556727
27	2.2212890	2.5315671	2.8833685	3.2820095	3.7334563
28	2.2879276	2.6201719	2 9987033	3.4296909	3.9201291
29	2.3565655	2.7118779	3.1186514	3.5840364	4.1161356
30	2.4272624	2.8067937	3.2433975	3.7453181	4.3219424
31	2.5000803	2.9050314	3.3731334	3.9138574	4.5380395
32	2.5750827	3.0067075	3.5080587	4 0899810	4.7649415
33	2.6523352	3.1119423	3 6483811	4.2740301	5.0031885
34	2.7319053	3.2280603	3.7945163	4.4663615	5 2533480
35	2.8138624	3.3335904	3 9466889	4.6673478	5.5160154
36	2.8982783	3.4502661	4 1039325	4.8773784	5 7918161
37	2.9852266	3.5710254	4.2680898	5.0968604	6.0814069
38	3.0747834	3.6960113	4.4388134	5.3262192	6.3854773
39	3.1670269	3.83537.9	4.6163659	5.5658990	6.7047511
40	3.2620377	3.9592597	4.8010206	5.8163645	7.0399887

TABLE

TABLE II.

The present worth of 1 *l.* for years.

Years.	3 *per cent.*	3½ *per cent*	4 *per cent.*	4½ *per cent.*	5 *per cent.*
1	.9708738	.9661836	.9615385	.9569378	.9523809
2	.9425959	.9335107	.9245562	.9157299	.9070295
3	.9151417	.9019427	.8889964	.8762966	.8638376
4	.8884870	.8714422	.8548042	.8385613	.8227025
5	.8626088	.8419732	.8219271	.8024511	.7835262
6	.8374843	.8135006	.7903145	.7678957	.7462154
7	.8130915	.7859910	.7599178	.7348285	.7106813
8	.7894092	.7594116	.7306902	.7031851	.6768394
9	.7664167	.7337310	.7025867	.6729044	.6446089
10	.7440939	.7089188	.6755642	.6439277	.6139133
11	.7224213	.6849457	.6496809	.6161987	.5846793
12	.7013799	.6617833	.6246971	.5896639	.5568374
13	.6809513	.6394041	.6005741	.5642716	.5305214
14	.6611178	.6177818	.5774751	.5399729	.5050679
15	.6418619	.5968906	.5552645	.5167204	.4810171
16	.6231669	.5767059	.5339082	.4644693	.4581115
17	.6050164	.5572038	.5133733	.4751764	.4362967
18	.5873946	.5383611	.4936281	.4528004	.4155207
19	.5702860	.5201557	.4746424	.4333018	.3957340
20	.5536758	.5025659	.4563870	.4146429	.3768895
21	.5375493	.4855709	.4388336	.3967874	.3589424
22	.5218925	.4691506	.42 9554	.3797009	.3418499
23	.5066917	.4532856	.4057 63	.3633501	.3255713
24	.4919337	.4379571	.3901 15	.3477035	.3100679
25	.4770056	.4231470	.3751 168	.3327306	.2953028
26	.4636947	.4088378	.3606892	.3184025	.2812407
27	.4501891	.3950123	.3468166	.3046914	.2678483
28	.4370768	.3816543	.3334775	.2915707	.2550936
29	.4243464	.3687482	.3206514	.2790150	.2429463
30	.4119868	.3562784	.3083187	.2670000	.2313775
31	.3999871	.3442304	.2964603	.2555024	.2203595
32	.3883370	.3325897	.2850579	.2444999	.2098662
33	.3770263	.3213427	.2740942	.2339712	.1998726
34	.3660449	.3104761	.2635521	.2238959	.1903548
35	.3553834	.2999769	.2534155	.2142544	.1812903
36	.3450 24	.2898 27	.2436 87	.2050282	.1726574
37	.3 .40829	.2800316	.2342569	.1961992	.1644356
38	.3252262	.2705619	.2252854	.1877504	.1566054
39	.3157536	.2614125	.2166506	.1796655	.1491479
40	.3065568	.2525725	.2082890	.1719287	.1420457

TABLE

TABLE III.

The amount of 1 *l. per annum*, or annuity for years.

Years.	3 *per cent.*	3½ *per cent.*	4 *per cent.*	4½ *per cent.*	5 *per cent.*
1	1.0000000	1 0000000	1.0000000	1.0000000	1 0000000
2	2.0300000	2.0350000	2 0400000	2 0450000	2.0500000
3	3.0909000	3.1062250	3.1216 00	3.1370250	3.1525000
4	4.1836270	4.2149429	4 2464640	4.2781912	4.3101250
5	5.3091358	5.3624059	5.4163226	5.4707097	5.5256312
6	6.4684099	6 5501522	6 6329755	6 7168917	6 8019128
7	7.6624622	7.7794075	7.8982945	8.0191518	8 1420084
8	8.8923360	9.0516866	9.2142263	9 380013	9.5491089
9	10.1591061	10.3684958	10 5827951	10.8021142	11.0265643
10	11.4638793	11.7313031	12 0061071	12.28820 4	12 5778925
11	12.8077957	13.1411919	13.4863514	13.8411788	14 2067871
12	14.1920296	14.6019616	15.0258055	15 4640318	15.9171265
13	15.6177904	16.1130303	16.6268377	17.1599133	17.7129828
14	17 0863242	17.6769864	18.2919112	18.9321094	19 5986320
15	18.5989139	19 2956 09	20.0235876	20.7840543	21.5785636
16	20.1568813	20 9710297	21.8245311	22 7193367	23.6574918
17	21.7615877	22.7050158	23.6975124	24 7417069	25.8403664
18	23.4144354	24 4996113	25.6454129	26 8550837	28.1323847
19	25.1168684	26.3571805	27 6712294	29 0635625	30.5390039
20	26.8703745	28.2796818	29.7780786	31.3714128	33.0659541
21	28.6764857	30 2694707	31.9692017	33 7831368	35.7192518
22	30.5367803	32. 3289022	34 2479698	36.3033779	38 5052144
23	32.4528837	34 4604137	36 6178886	38.9370299	41 4304751
24	34.4264-02	36.6665282	39.0826041	41.6891963	44.5019989
25	36.4592643	38.9498567	41.6459083	44 5652 01	47.7270983
26	38.5530422	41.3131017	44.3117446	47.5706446	51.1134538
27	40.7096335	43.7590602	47.0842144	50.7113 36	54 6691265
28	42.93 9225	46.2906273	49.9675830	5 • 99 3 32	58.4025828
29	45.2188502	48.0107993	52.9662863	57.42 0332	62.3227119
30	47.5754157	51.6226773	56 0849377	61.0070697	66 4388475
31	50.0026782	54.4294710	59.3283252	64.7523878	70 7607899
32	52.5027585	57.3345025	62.7014687	68 6662452	75 2988294
33	55 0778413	60.3412101	66 2095274	72 7562263	80.0637708
34	57.7301765	63.4531524	69.8579085	77.0302565	85.0669594
35	60.46 c818	66.6740127	73.6322248	81.4966180	90.3203073
36	63.2759443	70.0076032	77.5983138	86.1639658	95.8363227
37	66.1742226	73.4578693	81 : 022464	91.0413443	101.6281388
38	69.1594493	77.028894	85.9793362	96.1382048	107.7095458
39	72 2342327	80.724 9 67	90.4091497	101.4644240	114.0950231
40	75.4012597	84.550277	95 0255157	107.0303231	120.7997742

TABLE

TABLE IV.

The present worth of 1 *l per annum*, or annuity for years.

Years.	3 *per cent.*	$3\frac{1}{2}$ *per cent.*	4 *per cent.*	$4\frac{1}{2}$ *per cent.*	5 *per cent.*
1	0.9708738	0.9661836	0.9615385	0.9569378	0.9523809
2	1.9134697	1.8996943	1.8860947	1.8726678	1.8594104
3	2.8286114	2.8016370	2.7750910	2.7489644	2.7232480
4	3.7170984	3.6730782	3.6299852	3.5875257	3.5459505
5	4.5797072	4.5150524	4.4518223	4.3899767	4.3294767
6	5.4172914	5.3285530	5.2421369	5.1578725	5.0756921
7	6.2302829	6.1145439	6.0020547	5.8927009	5.7863734
8	7.0196922	6.8739555	6.7327448	6.5958861	6.4632128
9	7.7861089	7.6076865	7.4353314	7.2687905	7.1078217
10	8.5302028	8.3166053	8.1108955	7.9127782	7.7217349
11	9.2526241	9.0015510	8.7604763	8.5289169	8.3064142
12	9.9540040	9.6633343	9.3850733	9.1285838	8.8632516
13	10.6349553	10.3027385	9.9856473	9.6828524	9.3935730
14	11.2960731	10.9205205	10.5631223	10.2228253	9.8986409
15	11.9379351	11.5174109	11.1183868	10.7395457	10.3796580
16	12.5611020	12.0941168	11.6522049	11.2340151	10.8377685
17	13.1661185	12.6513206	12.1656680	11.7071914	11.2740622
18	13.7535131	13.1896817	12.6592961	12.1599918	11.6895869
19	14.3237991	13.7098374	13.1339385	12.5932936	12.0853328
20	14.8774748	14.2124033	13.5903253	13.0079365	12.4622103
21	15.4150241	14.6979742	14.0291589	13.4047239	12.8211527
22	15.9369166	15.1671248	14.4511142	13.7844248	13.1630026
23	16.4436084	15.6204105	14.8568405	14.1477749	13.4885739
24	16.9355421	16.0583676	15.2469619	14.4954784	13.7986418
25	17.4131477	16.4815146	15.6220787	14.8282089	14.0939445
26	17.8768424	16.8903523	15.9827678	15.1466115	14.3751853
27	18.3270315	17.2854645	16.3295844	15.4513028	14.6430336
28	18.7641082	17.6670188	16.6630618	15.7428735	14.8981272
29	19.0884546	18.0357670	16.9837132	16.0218885	15.1410735
30	19.6004413	18.3920454	17.2920318	16.2888885	15.3724510
31	20.0004285	18.7362758	17.5884921	16.5443969	15.5928104
32	20.3887655	19.0688656	17.8735500	16.7888.9	15.80 6766
33	20.7657918	19.3902082	18.1476441	17.0228621	16.0025491
34	21.1318367	19.7006842	18.4111962	17.2467580	16.1929035
35	21.4872200	20.0006012	18.6646116	17.46101 4	16.374 942
36	21.8322525	20.2904938	18.9082803	17.6660406	16.5468516
37	22.1672354	20.5705254	19.1425771	17.8622398	16.7112872
38	22.4924616	20.8410874	19.3678625	18.0499902	16.8678926
39	22.8082151	21.1024999	19.5844831	18.2296557	17.0170406
40	23.1147710	21.3550723	19.7927721	18.4018844	17.1590862

TABLE V.

The annuity which 1 *l.* will purchase for a number of years.

Years.	3 *per cent.*	3½ *per cent.*	4 *per cent.*	4½ *per cent.*	5 *per cent.*
1	1.0300000	1.0350000	1.0400000	1.0450000	1.0500000
2	.5226108	.5260465	.5301961	.5339976	.5378049
3	.3535304	.3569342	.3603485	.3637734	.3672086
4	.2690271	.2722511	.2754901	.2787437	.2820118
5	.2183546	.2214814	.2246271	.2277916	.2309748
6	.1845975	.1876682	.1907619	.1938784	.1970175
7	.1605064	.1635445	.1666096	.1697015	.1728198
8	.1424564	.1454767	.1485270	.1516097	.1547218
9	.1284339	.1314460	.1344930	.1375745	.1406901
10	.1172305	.1202414	.1232909	.1263788	.1295046
11	.1080775	.1110920	.1141490	.1172482	.1203889
12	.1004621	.1034840	.1065522	.1096662	.1128254
13	.0940295	.0970616	.1001437	.1032754	.1064558
14	.0885263	.0915707	.0946690	.0978203	.1010240
15	.0837666	.0868251	.0859411	.0931138	.0963423
16	.0796109	.0826848	.0858200	.0890154	.0922699
17	.0759525	.0790431	.0821685	.0854176	.0886991
18	.0727087	.0758168	.0789933	.0822369	.0855462
19	.0698139	.0729403	.0761386	.0794073	.0827450
20	.0672157	.0703611	.0735818	.0768761	.0802426
21	.0648718	.0680366	.0712801	.0746006	.0779961
22	.0627474	.0659321	.0691988	.0725457	.0759705
23	.0608139	.0640188	.0673091	.0706825	.0741368
24	.0590474	.0622728	.0655860	.0689870	.0724709
25	.0574270	.0606740	.0640120	.0674390	.0709525
26	.0559383	.0592054	.0625674	.0660214	.0695643
27	.0545642	.0578524	.0612387	.0647195	.0682919
28	.0532932	.0566027	.0600130	.0635208	.0671225
29	.0521147	.0554454	.0588790	.0624146	.0660455
30	.0510193	.0543713	.0578301	.0613915	.0650514
31	.0499989	.0533724	.0568554	.0604435	.0641321
32	.0490466	.0524415	.0559486	.0595632	.0632804
33	.0481561	.0515724	.0551036	.0587445	.0624900
34	.0473220	.0507597	.0543148	.0579819	.0617554
35	.0465393	.0499984	.0535773	.0572705	.0610717
36	.0458038	.0492842	.0528866	.0566058	.0604345
37	.0451116	.0486133	.0522396	.0559840	.0598398
38	.0444593	.0479821	.0516319	.0554017	.0592842
39	.0438439	.0473878	.0510608	.0548557	.0587646
40	.0432624	.0468278	.0505225	.0543431	.0582782

The application of the foregoing tables.

Prob. 1. Pprincipal, rate, and time being given, to find the amount.

Multiply the amount of 1 *l.* found in the firſt table at the rate and for the time given, by the propoſed principal, and the product gives the anſwer.

Exam. 1. What will 1000 *l.* amount to in 20 years, compound intereſt being allowed at 5 *per cent. per annum?*

In the firſt table under 5 *per cent.* and oppoſite to 20 years we have

2.6532977
1000

L. 2653 5 11¼. *Anſwer.*

Exam. 2. What will 1000 *l.* amount to, forborne 14 years and 3 months, at 5 *per cent.* compound intereſt?

1.9799316
1000

80) 1979.9316
24.7491

2004.6807

Hence if any ſum is let out at 5 *per cent.* compound intereſt, it will double itſelf in ſomething leſs than 14 years and ¼.

Prob. 2. Any principal, rate, and amount being given, to find the time.

Divide the amount by the principal, and the quotient will be the amount of 1 *l.* at the given rate which will be found in the firſt table under that rate, even with the time required.

Example. In what time will 1000 *l.* become 2653*l.* 5*s.* 11¼*d.* compound intereſt being allowed at 5 *per cent. per annum?*

1000) 2653.2977

2.6532977 which is found oppoſite to 20 years.

Prob. 3. Principal, time, and amount given, to find the rate of intereſt.

Divide the amount by the principal, and the quotient will be

be the amount of 1 *l.* which being found in the firſt table even with the given time, and under the rate required.

Exam. At what rate *per cent. per annum* will 1000 *l.* become 2653 *l.* 5 *s.* $11\frac{1}{4}$ *d.* in 20 years?

1000) 2653.2977

2.6532977 under 5 *per cent.*

Prob. 4. Amount, rate, and time being given, to find the principal.

Divide the amount given by the amount of 1 *l.* found in the firſt table, and the quotient will give the anſwer.

Exam. What principal ſum will amount to 2653 *l.* 5 *s.* $11\frac{1}{4}$ *d.* forborne 20 years, intereſt upon intereſt at 5 *per cent.*?

2.6532977) 2653.2977000

1000 *Anſwer.*

Prob. 5. Principal, rate, and time being given, to find the annuity.

Multiply the annuity which 1 *l.* will purchaſe at the rate and for the time given, found in the fifth table, by the principal, and the product will be the annuity required.

Exam. 1. A gentleman hath 1000 *l.* which he would ſell for an annuity to continue 20 years; what would be his yearly income for that time, ſuppoſing intereſt upon intereſt allowed him at 5 *per cent.*?

.0802425
1000

80.2425 = *L.* 80-4-$10\frac{1}{4}$ *Anſwer.*

Exam. 2. A farmer renews a 19 years leaſe; for 200 *l.* gratuity, to be paid at ſigning the leaſe; but for the farmer's conveniency it was changed to an yearly additional rent; how much muſt be paid annually, compound intereſt at 5 *per cent.* to compenſate the loſs the landlord ſuſtains of 500 *l.* ready money.

.082745
200

16.549000 = *L.* 16-10-$11\frac{3}{4}$. *Anſwer.*

Prob. 6. Principal, annuity, and rate being given, to find the time

Divide the annuity by the principal, and the quotient will be the annuity which 1 *l.* will purchaſe, at the given rate, which will be found in the fifth table under that rate, and even with the time required.

Example. An annuity of 80 *l.* 4 *s.* 10$\frac{1}{4}$ *d.* is purchaſed for 1000 *l.* at the rate of 5 *per cent.* compound intereſt; what time ought that annuity to continue?

1000) 80.2425

.082425 even with 20 years. *Anſwer.*

Prob. 7. Principal annuity, and time given, to find the rate.

Divide the annuity by the principal, and the quotient will be the annuity which 1 *l.* will purchaſe for the given time, which will ſtand even with the time, and under the required rate in the fifth table.

Example. If an annuity of 80 *l.* 4 *s.* 10$\frac{1}{4}$ *d.* to continue 20 years, be purchaſed for 1000 *l.* what rate of intereſt hath the purchaſer for his money?

1000) 80.2425

.082425 under 5 *per cent.* *Anſwer.*

Prob. 8. Annuity, rate, and time given, to find the amount.

Find the amount of 1 *l.* *per annum*, at the rate, and for the time given in table 3. by which multiply the annuity, and the product will be the amount required.

Example. What will an annuity of 80 *l.* 4 *s.* 10$\frac{1}{4}$ *d.* amount to in 20 years, compound intereſt being allowed at 5 *per cent.* *per annum.* ?

The amount of 1 *l.* for 20 years *per* table 3.

33.06595401
80.2425

1653297705
661319082
1321638164
661319082
2645276328

2653.29482186925 *Anſwer.*

Which will be found equal to the amount of 1000 *l.* in 20 years.

Prob.

Prob. 9. Annuity, rate, and amount given, to find the time.

Divide the amount by the annuity, and the quotient will be the amount of 1 l. *per annum* at the given rate, which will be found in the third table under that rate, and even with the time required.

Example. In what time will an annuity of 80 *l.* 4 *s.* 10¼ *d.* amount to 2653 *l.* 5 *s.* 10¼ *d.* compound interest at 5 *per cent.*?

80.2425) 2653.29482186925

33.0659541 even with 20 years.

Prob. 10. Annuity, time, and amount given, to find the rate.

Divide the amount by the annuity, and the quotient will be the amount of 1 *l. per annum*, for the given time; which will be found in the third table even with the given time, and below the required rate.

Example. At what rate *per cent. per annum* will an annuity of 80 *l.* 4 *s.* 10¼ *d.* amount to 2653 *l.* 5 *s.* 10¼ *d.* in 20 years?

80.2425) 2653.29482186925

33.0659541 in the 3d tab. below 5 *per cent.*

Prob. 11. Amount, rate, and time given, to find the annuity.

Divide the amount given by the amount of 1 *l.* found in the third table, at the rate and time given, and the quotient will be the annuity required.

Exam. What annuity will amount to *L.* 2653.29482186925 in 20 years, compound interest at 5 *per cent.*?

33.0659541) 2653.29482186925

80.2425 annuity. *Answer.*

Prob. 12. Principal sum in reversion, rate, and time given, to find the present value.

Multiply the present value of 1 *l.* for the rate and time given, as in table 2d. by the principal, and the product will be the answer.

Example. What is the present value of 2653 *l.* 5 *s.* 10¼ *d.* payable at the expiration of 20 years, at the rate of 5 *per cent. per annum*?

2653, *&c.*

2653.29482186925
3768895

1000. &c. *Anſwer.*

Prob. 13. Annuity, time in reverſion, and rate being given, to find the preſent value.

In the fourth table find the preſent value of 1 *l. per annum*, at the given rate, both for the time in being and the time in reverſion, added together, and ſubtract the time in being from the other, and multiply the remainder by the annuity, the product anſwers the queſtion.

Example. What is it worth in preſent money to add 14 years to a term of 7 years in being, and thereby make up the term of 21 years, the rent or annuity being 50 *l.* computing at the rate of 5 *per cent. per annum?*

The preſent value of 1 *l. per annum*, in the 4th table for 21 years is - - - 12.8211527
For 7 years 5.7863734

Difference 7.0347793
Multiplied by 50

351.7389650 *Anſwer.*

Prob. 14. An annuity ſeveral times in reverſion, and rate being given, to find the ſeveral preſent values.

Find the preſent value of *L.* 1 *per annum*, *per* table fourth, at the given rate, and for the ſeveral given times, which being ſeverally multiplied by the annuity, the products will be the ſeveral preſent values of that annuity, for the ſeveral times given; ſubtract the ſeveral preſent values, the one from the other, and the ſeveral remainders anſwer the queſtion.

Example. A has a term of 7 years in an eſtate of *L.* 50 *per annum*; *B* has a term of 14 years in the ſame eſtate in reverſion, after the ſeven years are expired; and *C* hath a farther term of 20 years, after the expiration of 21 years; it is required to know, what is the preſent value of the ſeveral terms, computing at the rate of 5 *per cent.*

The preſent value of 1 *l.* for 41 years × 50 = 864 14 $4\frac{1}{2}$
Ditto ditto for 21 years × 50 = 641 1 $1\frac{3}{4}$
Ditto ditto for 7 years × 50 = 289 6 $4\frac{1}{2}$

Therefore

Therefore *L.* 864 14 $4\frac{1}{4}$
641 1 $1\frac{3}{4}$

223 13 $2\frac{1}{2}$ *C*'s term.

641 1 $1\frac{3}{4}$
289 6 $4\frac{1}{2}$

351 14 $9\frac{3}{4}$ *B*'s term.

575 7 $11\frac{3}{4}$ the sum of *B*'s and *C*'s.

289 9 $4\frac{1}{4}$ *A*'s term.

Prob. 15. Any annuity in fee simple, and rate being given, to find the present value.

Multiply the present value of *L.* 1 *per annum*, *per* table fourth, at the given rate by the annuity, and the product gives the answer.

Example What is the value of an estate of *L.* 100 *per annum* in fee simple, computing at the rate of 5 *per cent. per annum*?

100
20

L 2000 *Answer.*

Prob. 16. The principal and rate given, to find the annuity in fee simple.

This is the reverse of the last problem, therefore divide the principal by the present value of 1 *l. per annum* in fee simple, and the quotient will be the answer.

Example. What annuity in fee simple will 2000*l.* purchase, at the rate of 5 *per cent. per annum*?

$$\frac{2000}{20} = 100 \text{ } \textit{Answer.}$$

Promiscuous examples.

Exam. 1. A person having 12 years to run in a lease of an estate of 60 *l. per annum*, of 60 *l.* for 40 years, would know what present money he must pay, in order to complete the lease by adding 28 years thereto, computing at 5 *per cent.* compound interest?

By

By table 4 the preſent value of 1 *l. per annum* at 5 *per cent.* for 40 years, is	17.1590862
By the ſame table, the value of 1 *l. per annum* at that rate, for 12 years to run, is	8.8632516
Difference	8.2958346
Multiply by	60
Anſwer	497.7500760

Exam. 2. For a leaſe of certain profits for 7 years, *A* offers to pay 150 *l.* gratuity, and 300 *l. per annum*; *B* offers 400 *l.* gratuity, and 250 *per annum*; *C* bids 650 *l.* gratuity, and 200 *l. per annum*; and *D* offers 1800 *l.* for the whole purchaſe, without any yearly rent: *Query*, which is the beſt offer, and what the difference, computing at 5 *per cent.*?

By table 4. the preſent worth of 300 *l. per annum*, for 7 years at 4 *per cent.* is	L. 1850.6164
To which add	150.
Value of *A*'s offer	1950.6164
The preſent worth of 250 *l. per annum* for 7 years	1500.5136
Add	400
Value of *B*'s offer	1900.5136
The preſent worth of 200 *l. per annum* for 7 years	1200.4109
Add	650
Value of *C*'s offer	1850.4109
D's offer	1800.

Hence it appears that *A*'s is the beſt offer, and that, rejecting the decimals, he bids 50 *l.* more than *B*, 100 *l.* more than *C*, and 150 l. more than *D*.

Exam. 3. Which is moſt advantageous, a term of 19 years of an eſtate of 100 *l. per annum*, or the reverſion of ſuch an eſtate for ever, at the expiration of the ſaid 19 years, computing at the rate of 4 *per cent.* compound intereſt?

A freehold eſtate of 100 *l. per annum*, at 4 *per cent.* is worth £. 2500

And by table 4. the preſent worth of 100 *l.* annuity for 19 years at 4 *per cent.* is =1313.39385

Conſequently the reverſion is worth 1186.60615

Hence it appears, that the firſt term of 19 years, is better than the reverſion ever after, by 126.7877=£. 126 : 15 : 9.

Exam. 4. What annuity would be ſufficient to pay off a debt of 100 millions at 4 *per cent.* compound intereſt, in 30 years?

By table 5. even with 30 years and under 4 *per cent.* .0578301
100000000

5.783 010.

So that ſuppoſing the national debt to be 100 millions, the intereſt at 4 *per cent.* would be 4.000.000

It would require a ſinking fund of 17.83.010
to clear the national debt in 30 years.

Variety XVII. ANNUITIES on LIVES.

AS annuities upon lives are daily bought and ſold, and at this time become a very conſiderable branch of buſineſs, I ſhall here offer the public, in miniature, the ſubſtance of what the beſt writers upon this ſubject have communicated at greater length.

The value of an annuity for life, depends as well upon the intereſt which money bears, as the probability of the life continuing a longer or ſhorter time; the former of which is generally ſettled by law, but the latter can only be determined by obſervation.

TABLE I.

Shewing the probabilities of life from the lateſt obſervations made at LONDON.

N° of perſons.	Ages curr.	N° of perſons.	Ages curr.	N° of perſons.	Ages curr.	N° of perſons.	Ages curr.
1280	born.	462	20	294	40	130	60
410 *		7 *		10 *		7 *	
870	1	455	21	284	41	123	61
170 *		7 *		10 *		6 *	
700	2	448	22	274	42	117	62
65 *		7 *		10 *		6 *	
635	3	441	23	264	43	111	63
35 *		7 *		9 *		6 *	
600	4	434	24	255	44	105	64
20 *		8 *		9 *		6 *	
580	5	426	25	246	45	99	65
16 *		8 *		9 *		6 *	
564	6	418	26	237	46	93	66
13 *		8 *		9 *		6 *	
551	7	410	27	228	47	87	67
10 *		8 *		8 *		6 *	
541	8	402	28	220	48	81	68
9 *		8 *		8 *		6 *	
532	9	394	29	212	49	75	69
8		9 *		8 *		6 *	
524	10	385	30	204	50	69	70
7 *		9 *		8 *		5 *	
517	11	576	31	196	51	64	71
7 *		9 *		8 *		5 *	
510	12	367	32	188	52	59	72
6 *		9 *		8 *		5 *	
504	13	358	33	180	53	54	73
6 *		9 *		8 *		5 *	
498	14	349	34	172	54	49	74
6 *		9 *		7 *		4 *	
492	15	340	35	165	55	45	75
6 *		9 *		7 *		4 *	
486	16	331	36	158	56	41	76
6 *		9 *		7 *		3 *	
480	17	322	37	151	57	38	77
6 *		9 *		7 *		3 *	
474	18	313	38	144	58	35	78
6 *		9 *		7 *		3 *	
468	19	304	39	137	59	32	79
6 *		10 *		7 *		3 *	
462	20	294	40	130	60	29	80

Note, The numbers marked thus * are ſuppoſed to die off yearly.

TABLE

TABLE II.

For the valuation of annuities upon one life.

Age.	Years purch. at 5 per cent.	Years purch. at 4 per cent.	Years purch. at 3 per cent.	Age.	Years purch. at 5 per cent.	Years purch. at 4 per cent.	Years purch. at 3 per cent.
6	14.1	16.2	18.8	41	10.2	11.4	13.0
7	14.2	16.3	18.9	42	10.1	11.2	12.8
8	14.3	16.4	19 0	43	10.0	11.1	12.6
9	14.3	16.4	19.0	44	9.9	11 0	12.5
10	4 3	16.4	19.0	45	9.8	10 8	12.3
11	14.3	16.4	19.0	46	9.7	10.7	12,1
12	14.2	16.3	18.9	47	9.5	10.5	11.9
13	14.1	16.2	18.7	48	9.4	10.4	11.8
14	14.0	16.0	18.5	49	9.3	10.2	11.6
15	13.9	15.8	18.3	50	9.2	10.1	11.4
16	13.7	15.6	18.1	51	9.0	9.9	11.2
17	13.5	15.4	17.9	52	8.9	9.8	11.0
18	13 4	15.2	17 6	53	8.8	9.6	10.7
19	13.2	15.0	17.4	54	8.6	9.4	10.5
20	13.0	14.8	17.2	55	8.5	9.3	10.3
21	12.9	14.7	17.0	56	8.4	9.1	10.1
22	12.7	14 5	16.8	57	8.2	8 9	9.9
23	12.6	14.3	16.5	58	8.1	8.7	9.6
24	12.4	14.1	16.3	59	8.0	8.6	9.4
25	12.3	14.0	16.1	60	7.9	8.4	9.2
26	12.1	13 8	15.9	61	7.7	8.2	8.9
27	12.0	13.6	15.6	62	7.6	8.1	8.7
28	11.8	13.4	15.4	63	7.4	7.9	8.5
29	11.7	13.2	15.2	64	7.3	7.7	8.3
30	11.6	13.1	15.0	65	7.1	7.5	8.0
31	11.4	12.9	14.8	66	6.9	7.3	7.8
32	11.3	12.7	14.6	67	6.7	7.1	7.6
33	11.2	12.6	14.4	68	6.6	6.9	7.4
34	11.0	12.4	14.2	69	6.4	6.7	7.1
35	10.9	12.3	14.1	70	6.2	6.5	7.9
36	10.8	12.1	13.9	71	6.0	6.3	6.7
37	10.6	11.9	13.7	72	5.8	6.1	6.5
38	10.5	11.8	13.5	73	5.6	5.9	6.2
39	10.4	11.6	13.3	74	5.4	5.6	5.9
40	10.3	11.5	13.2	75	5.2	5.4	5.6

TABLE III.

For the valuation of annuities upon two joint lives.

Mean age.	Years purch. at 5 *per cent.*	Years purch. at 4 *per cent.*	Years purch. at 3 *per cent.*	Mean age.	Years purch. at 5 *per cent.*	Years purch. at 4 *per cent.*	Years purch. at 3 *per cent.*
6	11.3	12.7	14.4	41	7.2	8.0	8.9
7	11.5	12.9	14.6	42	7.1	7.8	8.7
8	11.6	13.0	14.7	43	7.0	7.7	8.6
9	11.6	13.0	14.7	44	6.9	7.6	8.5
10	11.6	13.0	14.7	45	6.7	7.4	8.3
11	11.5	12.9	14.6	46	6.6	7.3	8.2
12	11.4	12.8	14.5	47	6.5	7.2	8.1
13	11.3	12.7	14.3	48	6.4	7.1	7.9
14	11.2	12.5	14.1	49	6.3	7.0	7.8
15	11.0	12.3	13.9	50	6.2	6.8	7.6
16	10.8	12.1	13.7	51	6.1	6.7	7.4
17	10.7	11.9	13.5	52	6.0	6.6	7.3
18	10.5	11.7	13.2	53	5.9	6.5	7.2
19	10.3	11.5	13.0	54	5.8	6.3	7.0
20	10.1	11.3	12.8	55	5.7	6.2	6.9
21	10.0	11.2	12.6	56	5.6	6.1	6.7
22	9.8	11.0	12.4	57	5.5	6.0	6.6
23	9.7	10.8	12.2	58	5.4	5.8	6.4
23	9.5	10.6	12.0	59	5.3	5.7	6.3
25	9.4	10.5	11.8	60	5.2	5.6	6.1
26	9.2	10.3	11.6	61	5.1	5.5	6.0
27	9.1	10.1	11.4	62	5.0	5.4	5.9
28	8.9	9.9	11.2	63	4.9	5.3	5.7
29	8.8	9.8	11.0	64	4.8	5.1	5.5
30	8.6	9.6	10.8	65	4.7	5.0	5.4
31	8.5	9.4	10.6	66	4.6	4.9	5.3
32	8..	9.2	10.4	67	4.5	4.8	5.1
33	8.2	9.1	10.2	68	4.4	4.6	4.9
34	8.1	8.9	10.0	69	4.3	4.5	4.8
35	8.0	8.8	9.9	70	4.2	4.4	4.6
36	7.8	8.6	9.7	71	4.1	4.3	4.5
37	7.6	8.4	9.5	72	3.9	4.1	4.3
38	7.5	8.3	9.3	73	3.8	4.0	4.2
39	7.4	8.2	9.2	74	3.7	3.8	4.0
40	7.3	8.1	9.1	75	3.6	3.7	3.8

TABLE IV.

For the valuation of annuities upon the longeſt of two lives.

Mean age.	Years purch. at 5 *per cent.*	Years purch. at 4 *per cent.*	Years purch. at 3 *per cent.*	Mean age.	Years purch. at 5 *per cent.*	Years purch. at 4 *per cent.*	Years purch. at 3 *per cent.*
6	16.9	19.7	23.3	41	13.2	14.9	17.0
7	17.0	19.8	23.4	42	13.1	14.7	16.8
8	17.1	19 9	23.5	43	13.0	14.5	16.5
9	17.1	19 9	23.5	44	12.9	14.3	16.3
10	17.1	19.9	23.5	45	12.8	14.2	16.1
11	17.1	19.9	23 5	46	12.6	14.0	15.8
12	17.0	19.8	23.4	47	12.5	13.8	15.6
13	16.9	19.7	23.3	48	12.4	13.6	15.3
14	16.7	19.5	23.1	49	12.2	13.4	15.1
15	16.6	19.3	22.9	50	12.1	13.3	14.9
16	16.4	19.1	22.6	51	11.9	13.1	14.6
17	16.2	18.9	22.4	52	11.8	12.9	14.4
18	16.1	18.7	22 1	53	11,6	12.7	14.1
19	15 9	18.5	21.9	54	11.5	12.5	13.9
20	15.7	18.3	21.6	55	11.3	12.3	13.6
21	15.6	18.2	21.3	56	11.2	12.1	13 4
22	15 4	18.0	21.1	57	11.0	11.9	13.1
23	15.3	17.8	20.8	58	10.9	11.7	12.8
24	15.1	17.6	20.6	59	10.7	11.5	12.5
25	15.0	17 4	20.3	60	10.5	11.2	12.2
26	14.9	17.3	20.1	61	10.3	11 0	12.0
27	14.7	17.1	19.9	62	10.1	10.8	11.7
28	14.6	16.9	19.7	63	9 9	10.5	11.4
29	14.5	16.8	19.5	64	9.7	10.3	11.1
30	14.4	16 6	19.3	65	9.4	10.0	10.8
31	14.2	16.4	19.1	66	9.2	9.7	10.5
32	14.1	16.2	18.9	67	8.9	9.4	10.2
23	14.0	16.1	18.7	68	8.7	9.2	9.9
34	13.9	15.9	18.5	69	8.5	8.9	9.5
35	13.8	15.8	18.3	70	8.2	8.6	9.2
36	13.7	15.6	18.1	71	8.0	8 4	8.0
37	13.6	15 5	17.9	72	7.7	8.1	8.6
38	13.5	15.3	17.7	73	7.5	7.8	8.2
39	13.4	15.2	17.5	74	7.2	7.5	7.9
40	13.3	15.0	17.3	75	6.9	7.2	7.6

TABLE V.

For the valuation of annuities upon three joint lives.

Mean age.	Years purch. at 5 per cent.	Years purch. at 4 per cent.	Years purch. at 3 per cent.	Mean age.	Years purch. at 5 per cent.	Years purch. at 4 per cent.	Years purch. at 3 per cent.
6	9.7	10.6	11.7	41	5.5	6.1	6.8
7	9.9	10.8	11.9	42	5.4	6.0	6.7
8	10.0	10.9	12.0	43	5.4	5.9	6.5
9	10.0	10.9	12.0	44	5.3	5.8	6.4
10	10.0	10.9	12.0	45	5.2	5.7	6.3
11	9.9	10.8	11.9	46	5.1	5.6	6.2
12	9.8	10.7	11.8	47	5.0	5.5	6.1
13	9.6	10.5	11.6	48	5.0	5.4	5.9
14	9.5	10.4	11.4	49	4.9	5.3	5.8
15	9.3	10.2	11.2	50	4.8	5.2	5.7
16	9.2	10.0	11.0	51	4.7	5.1	5.6
17	9.0	9.8	10.8	52	4.7	5.1	5.5
18	8.8	9.6	10.6	53	4.6	5.0	5.4
19	8.6	9.4	10.4	54	4.5	4.9	5.3
20	8.4	9.2	10.2	55	4.4	4.8	5.2
21	8.2	9.0	10.0	56	4.4	4.7	5.1
22	8.1	8.9	9.8	57	4.3	4.6	5.0
23	7.9	8.7	9.6	58	4.2	4.5	4.9
24	7.7	8.5	9.4	59	4.1	4.4	4.8
25	7.6	8.3	9.2	60	4.0	4.3	4.6
26	7.4	8.1	9.0	61	3.9	4.2	4.5
27	7.3	8.0	8.8	62	3.8	4.1	4.4
28	7.1	7.8	8.6	63	3.7	4.0	4.3
29	7.0	7.7	8.5	64	3.7	3.9	4.2
30	6.8	7.5	8.3	65	3.6	3.8	4.1
31	6.7	7.4	8.2	66	3.5	3.7	3.9
32	6.5	7.2	8.0	67	3.4	3.6	3.8
33	6.4	7.1	7.9	68	3.3	3.5	3.7
34	6.2	6.9	7.7	69	3.2	3.4	3.6
35	6.1	6.8	7.6	70	3.1	3.2	3.4
36	6.0	6.7	7.4	71	3.0	3.1	3.3
37	5.9	6.5	7.2	72	2.9	3.0	3.1
38	5.8	6.4	7.1	73	2.8	2.9	3.0
39	5.7	6.3	7.0	74	2.6	2.7	2.8
40	5.6	6.2	6.9	75	2.5	2.6	2.7

TABLE VI.

For the valuation of annuities upon the longeſt of three lives.

Mean age.	Years purch. at 5 per cent.	Years purch. at 4 per cent.	Years purch. at 3 per cent.	Mean age.	Years purch. at 5 per cent.	Years purch. at 4 per cent.	Years purch. at 3 per cent.
6	18.0	21.0	25.0	41	14.6	16.4	18.9
7	18.1	21.1	25.1	42	14.5	16.3	18.7
8	18.2	21.2	25.2	43	14.4	16.2	18.5
9	18.2	21.2	25.2	44	14.3	16.0	18.2
10	18.2	21.2	25.2	45	14.2	15.9	18.0
11	18.2	21.2	25.2	46	14.1	15.7	17.7
12	18.1	21.1	25.1	47	13.9	15.5	17.5
13	18.0	21.0	25 0	48	13.8	15.2	17.2
14	17.9	20.9	24.8	49	13.7	15.1	17.0
15	17.8	20.7	24.6	50	13.5	5.9	16.7
16	17.6	20.5	24.3	51	13.4	14 7	16.5
17	17.5	20 3	24.1	52	13.2	14.5	16.2
18	17.3	20.1	23.8	53	13.1	14.3	15.9
19	17.2	19.9	23.5	54	12.9	14.1	15.7
20	17.0	19.7	23.3	55	12.8	13.9	15.4
21	16.9	19.5	23.1	56	12.6	13.7	15.1
22	16.8	19.4	22.8	57	12.5	13.5	14.8
23	16.6	19.2	22.6	58	12 3	13.2	14.5
24	16.5	19.0	22 3	59	12.1	12 9	14.1
25	16.4	18 8	22.1	60	11.9	12.7	13.8
26	16.3	18.7	21.9	61	11.7	12.5	13.5
27	16.1	18,5	21.6	62	11 5	12.2	13 1
28	16 0	18.3	21.4	63	11.3	11.9	12.8
29	15.9	18.2	21.2	64	11.0	11.6	12.5
30	15.8	18.0	21.0	65	10.8	11.4	12.2
31	15.6	17.8	20.8	66	10.5	11.1	11.8
32	15.5	17.7	20.6	67	10.2	10.8	11.5
33	15.4	17.6	20.4	68	9 9	10.5	11.2
34	15.3	17.4	20.2	69	9.6	10.2	10.9
35	15.2	17.3	20.0	70	9.3	9.9	10.5
36	15.1	17.2	19.9	71	9.0	9.6	10.2
37	15.0	17.0	19 7	72	8.7	9.2	9.8
38	14.9	16.9	19 5	73	8.4	8.9	9.5
39	14.8	16.7	19 3	74	8.1	8.6	9.1
40	14.7	16.6	19.1	75	7 8	8.2	8.7

Uſe

Uſe and explanation of the firſt table.

Suppoſe it was required to find the probability which a perſon of 40 years of age hath to live 30 years longer, that is, to the age of 70; look in the table againſt 40 years and 70 years, fronting which will be found 294 and 69 reſpectively; ſhewing that out of 294 perſons living of 40 years of age, no more than 69 arrive at the age of 70; therefore ſince the whole number of perſons living at the beginning of this term, is to the number remaining alive at the end of it, in the *ratio* of 294 to 69; the number of chances that a perſon of 40 years hath to live 30 years longer, will be to the number of all the chances, that he hath both to live beyond, and die within 30 years, in the ſame *ratio* of 294 to 69; conſequently $\frac{69}{294}$ is the meaſure of the probability required; the probability that any event will happen, being always to be conſidered as the *ratio* of the chances which that event hath to happen, to all the chances which that event hath to happen and fail. Hence in ordinary caſes may the premiums for inſurance on lives be eſtimated, and annuities bought and ſold, in proportion to the riſk; which is obvious from this table.. For inſtance, ſuppoſe it were required to find the value of an annuity of 100*l.* for a life of 20 years of age, intereſt 4 *per cent.*——Becauſe the preſent value of 100*l.* due at the expiration of one year, is *L.* 96.15; it is plain that *L.* 96 15 would be the value of the firſt year's annuity paid down was the purchaſer ſure of recovering it; but the probability of his living one year, appearing from the table to be only $\frac{455}{462}$, the ſum of *L.* 96.15 muſt be diminiſhed in the ratio of 462 to 455, in order to make a juſt deduction out of it, for the contingency of his dying before the end of one year, which will reduce it to 94.7, equal to the true value of the firſt year's annuity.. After the ſame manner may the value of the ſecond year's annuity be calculated; for ſince the probability of receiving the ſecond year's annuity is in the *ratio* of 462 to 448, the preſent value of 100 to be received at the end of two years, when the proportional diſcount is allowed for $\frac{448}{462}$ will be found to be *L.* 89.65. In like manner may the 3d, 4th, 5th, 6th, *&c.* years annuity be computed to the utmoſt extent of life, the ſum of all which will be the value of the annuity required.

Problems

Problems applying the uſe of the foregoing tables.

Prob. 1. To find the value of an annuity for an aſſigned life.

RULE.

In table 2. againſt the given age, and under the aſſigned rate of intereſt, will ſtand the number of years purchaſe which an annuity upon that life is worth.

EXAMPLES.

Exam. 1. Suppoſe one of 20 years of age would ſell an annuity of 100 *l.* during his life, what ready money would the annuity be worth, intereſt being allowed at 4 *per cent.*?

SOLUTION.

Firſt, oppoſite to 20 years and under 4 *per cent.* we have in table 2. 14.8, which aſcertains the value to be ſo many years purchaſe, and by multiplying 14.8 into the annuity 100 *l.* we have 1480 *l.* for the anſwer or preſent worth.

Exam. 2. A widow lady, with 200 *l.* a-year jointure, aged 30 years, marries a young merchant, who, to enlarge his capital, propoſes to ſell the jointure; what ready money ſhould he receive, diſcounting intereſt at 5 *per cent.*

SOLUTION.

Oppoſite to 30 and under 5 *per cent.* we have 11.6 for the years purchaſe, which multiplied into 200=2320 *l.* *Anſwer.*

Prob. 2. To find the value of an annuity upon two aſſigned joint lives.

Caſe 1. If the two lives be equal, the anſwer is found at once *per* table 3.

EXAMPLE.

Suppoſe it were required to find the value of an annuity, 50 *l.* for inſtance, upon two joint lives, each 20 years, intereſt 5 *per cent.*

SOLUTION.

Oppoſite to 20 and under 5 *per cent.* in table 3. we have

10.1 the number of years purchaſe, which multiplied by 50 *l.* the annuity, produceth 505 *l.* for the anſwer.

Caſe 2. If the given ages be unequal, but neither leſs than 25, nor exceeding 50, take half the ſum of the two for a mean age, and then proceed as in caſe 1.

Example. There are two joint lives upon an annuity of 500 *l.* the age of the one is 30, and that of the other 40; what is the preſent worth of that annuity, intereſt 4 *per cent.*

SOLUTION.

30
40

2) 0

35 mean age *per* table 3.=8.8 years purchaſe.
5co annuity.

L. 4400 *Anſwer.*

Caſe 3. If one or both ages be without the limits 25 and 50, multiply the difference by one half the leſſer of the two values, and divide the product by the greater, and the quotient added to the leſſer value will give the anſwer very near.

EXAMPLES.

Exam. 1. Let the one age be 12 and the other 60 upon an annuity of 100 *l.* intereſt 5 *per cent.*

SOLUTION.

Per table 3. 12=11.4
60= 5.2

6.2 difference.
2.6½ the leſſer value.

372
124

11.4) 16.12

1.414 quotient.
5.2 leſſer value.

6.614 ſum.
100

L. 661.4 *Anſwer.*

Exam

Exam. 2. Let the age of the one be 8, and the other 30; annuity and intereſt as above.

SOLUTION.

8=11.6
30= 7.8

3.8
3.9

11.6) 14.82

1.279
7.8

9.979
100

907.9 *Anſwer.*

Prob. 3. To find the value of an annuity upon two lives to continue as long as either of them is in being.

Caſe 1. If the lives are equal, find the given age in tab. 4. and againſt it, under the propoſed rate of intereſt, will be the number of years purchaſe required.

EXAMPLE.

Suppoſe each of the ages 30, the annuity 100 *l.* intereſt 3 *per cent.*

SOLUTION.

Oppoſite to 30, table 4. under 3 *per cent.* 19.3
100

L. 1930 *Anſwer.*

Caſe 2. If both ages be between 25 and 50, take half their ſum for a mean age, and then proceed as before.

EXAMPLE.

Suppoſe one of the ages 28, and the other 48, annuity 100 *l.* intereſt 5 *per cent.*

SOLUTION.

28		Or	28=14.6
48			48=12.4
2) 76			2) 27.0
38=13.5			13.5
	100		
	1350 *Anſwer.*		

Caſe 3. If the given ages do not correſpond to the limitations 25 and 50, find the value of the two joint lives by the laſt caſe of the preceding problem, which ſubtract from the ſum of the values of the two ſingle lives, and there will remain the required value of an annuity upon the longeſt life.

EXAMPLE.

Let the one age be 12, and the other 60 upon an annuity of 100 *l.* intereſt 5 *per cent.*

SOLUTION.

Per table 4. 12=17
and 60= 9.2

26.2 ſum.

Per prob. 2. caſe 3. value of 2 ſuch joint lives. } 6.614

19.586=*L.* 1958.6 *Anſwer.*

Prob. 4. To find the value of an annuity upon three joint lives.

Caſe 1. If all the lives are equal, the number of years purchaſe is found at once *per* table 5.

EXAMPLE.

Suppoſe there are three joint lives upon an annuity of 100 *l.* intereſt 5 *per cent.* each 25 years of age——required the value.

SO-

SOLUTION.

Per table 5. 25=7.6
100

L. 760 *Anſwer.*

Caſe 2. If all the three ages be between 15 and 55, and the difference betwixt the greateſt and leaſt not more than 15, $\frac{1}{3}$ of the ſum of their ages will be a mean age, with which proceed as in caſe 1.

EXAMPLE.

Suppoſe there are three joint lives upon an annuity of 100 *l.* 5 *per cent.* intereſt, *viz.* *A*, *B*, and *C*; *A* is 20 years of age, *B* 26, and *C* 30; required the value.

20
26
30

2) 76

38=5.8
100

580

Caſe 3. If one or all of the ages be without the limitations preſcribed in the laſt caſe, multiply the ſum of the three correſponding values by the ſquare of the leaſt of them, reſerving the product; then multiply the two greater values into each other, and to the double of the product add the ſquare of the leſſer value, divide the reſerved product by this ſum, and ſubtract the quotient from twice the leſſer value, and the remainder will give the years purchaſe.

EXAMPLE.

Let the three ages be 13, 31$\frac{1}{2}$, and 53, intereſt 4 *per cent.*
The value correſponding to 13 =10.5
to 31$\frac{1}{2}$= 7.3
and to 53 = 5

Sum =22.8
5×5= 25

Product to be reſerved 570 Then

Then 10.5×7.3=76.65
2

153.30
25

178.3 (570.0

L.

5×2=10−3.2=6.8×100=680 *Anſwer.*

Prob. 5. To find the value of an annuity upon the longeſt of three lives.

Caſe 1. If the ages be all equal, the anſwer will be found at once by table 6.

EXAMPLE.

Suppoſe the three ages be each 30 years for 100 *l.* annuity, intereſt 5 *per cent.*

SOLUTION.

Per table 6. 30=15.8 years purchaſe.
100 annuity.

L. 1580 value.

Caſe 2. If none of the ages be below 10 or above 60, and the difference betwixt the greateſt and leaſt of them not exceeding 15; to double the ſum of the two leaſt add the greateſt, and take $\frac{1}{4}$ of the ſum for a mean age, with which proceed as in the laſt caſe.

EXAMPLE.

Let the propoſed ages be 16, 24, and 30; annuity 100 l. and intereſt 5 *per cent.*

SOLUTION.

16×2=32, 24×2=48 } twice the ſum of the two leaſt.
30 the greateſt.

5) 110

Mean age 22=19 4 *per* table 6.
100

L. 1940 value.

Caſe

Caſe 3. If the given ages do not correſpond to the limitations in the laſt caſe; find the value anſwering to the greateſt of the given ages *per* table 4 and the values correſponding to all the three ſeveral ages by table 6. and let the difference of the two values anſwering to the greateſt age be taken and reſerved; let the ſquare of the greater of theſe two be divided by the product of the two other remaining values; multiply the ſquare of the quotient by the reſerved difference, then this laſt product, added to the value of an annuity for the two youngeſt lives, will be the value required.

EXAMPLE.

Let the three ages be reſpectively 20, 36, and 60; annuity 100 *l.* and intereſt 4 *per cent.*

SOLUTION.

60=12.7 *per* table 6.
60=11.2 *per* table 4.

1.5 difference.

Then 20=19.7, 36=17.2 } *per* table 6.

338.84) 161.29=12.7×12.7

.5×.5=.25
1.5

Value of the two youngeſt lives by caſe 2. prob. 3. } =17.·375

17.375
100

1737.5 *Anſwer.*

Variety XVIII. Menſuration of Surfaces and Solids.

SECT. I. *Of Surfaces.*

SUrfaces are meaſured by the ſuperficial inch, foot, or yard, according to the ſtated meaſures of different countries, and

and the meaſures peculiar to different artiſts, as carpenters, plaſterers, ſurveyors of land. The ſuperficial inch is any ſmall ſurface of 1 inch length and breadth; and becauſe 12 inches make 1 foot of long meaſure, $12\times12=144$ inches make 1 ſuperficial foot, 9 feet make 1 yard, $30\frac{1}{4}$ yards make 1 perch, 40 perches make 1 rood, and 4 roods make 1 acre of land-meaſure. The ſuperficial content of every ſurface is found by the proper rule of its figure, whether ſquare, triangle, polygon, or circle.

The ſuperficial content or area of rectangular ſquare figures, whether equal or oblong, is obtained by multiplying the length by the breadth; the product gives the content of the ſame name with the dimenſions taken, either inches, yards, or feet, accordingly.

Exam. 1. What is the ſuperficial content of a board 15.5 feet long, and 3.5 feet broad? Here the dimenſions being taken in feet, the product will be ſuperficial feet, $15.5\times3.5=54.25$, the anſwer required. To perform this and the like by the ſliding rule: Set 1 on the line *A* to 15.5 on the line *B*; look for 3.5 on the line *A*, and oppoſite to this you have 54.25 on the line *B*; or on the gunter two foot ſcale, extend the compaſs from 1 to 15.5; that diſtance laid the ſame way from 3.5 will reach to 54.25, the anſwer required.

Exam. 2. What is the content of a deal 14.5 feet long and 15 inches broad? Here the length being given in feet, and the breadth in inches, ſay, if 12 inches give 14.5 feet, what will 15 inches give? $14.5\times15\div12=18.125$, which is the anſwer in feet. By the ſliding rule, ſet 12 on *A* to 14.5 on *B*: and oppoſite to 15 on *A* you have 18.125 on *B*: or on the gunter, the extent from 12 to 14.5 will reach the ſame way from 15 to 18.125. If there were a number of ſuch deals to be meaſured, ſuppoſe 50, you need only multiply the content of one 18.125 by 50, the product 906.25 is the content of the whole.

The ſuperficial content of a triangle is found by multiplying $\frac{1}{2}$ of the baſe by the perpendicular falling on that baſe from the oppoſite angle. For example, let it be required to find in acres the area of a triangular piece of ground, 46 chains by the baſe, and 18 by the perpendicular, $23\times18=414$ ſquare chains, which divided by 10, the number of ſquare chains in an acre, quotes 41.4 acres. By the ſliding rule, ſet 10 on *A* to 23 on *B*; and oppoſite to 18 on *A* you have

41.4 acres on *B*; on the gunter, the extent from 10 to 23 reaches from 18 to 41.4.

The ſuperficial content of a trapezoid, or the ſegment of a triangle cut by a line parellel to the baſe, is found by adding the parellel ſides together, and multiplying $\frac{1}{2}$ of that ſum by the perpendicular breadth, the product is the content.

An example of this in ſlaters work: Suppoſe a pavilion roof the oppoſite ſides equal trapezoids; let one of the ſides be 81 feet long below, and 62 above, the breadth 30; let the other ſide be 54 feet below, and 41 above, the breadth 30; required the number of ſuperficial yards of ſlating in the whole?

81+62=143÷2=71.5 Then 54+41=95÷2=47.5
Add 47.5

119.×30=3570÷9=396$\frac{2}{3}$ yards, which doubled for the oppoſite ſides give 793$\frac{1}{3}$ yards in all. By the ſliding rule, ſet 9 on *A* to 119 on *B*, becauſe the dimenſions are taken in feet, and the content required in yards; then look for 30 on *A*, againſt which you find 396.6 on *B*, which double for the anſwer.

Trapeziums, or irregular quadrilateral figures, are divided by a diagonal into two triangles, and the content of each found, by the rule proper to a triangle mentioned above. An example in land meaſure. Suppoſe a quadrilateral piece of ground the diagonal 22 chains 40 links, the perpendicular falling on this diagonal from one of the oppoſite angles 12 chains 30 links, and from the other oppoſite angle 9 chains 25 links, required the content in acres? Add the 2 perpendiculars together, 12 chains 30 links + 9 chains 25 links = 21 chains 55 links, by which multiply half the diagonal 11:20; the product is 241.36 ſquare chains, this divided by 10=24 acres, and .136 remaining; bring the remainder to roods by 4=.544, and then to perches by 40, the whole content is 24 acres 0 roods 21 perches. By the ſliding rule, ſet 10 on *A* to 21.5 on *B*, and oppoſite to 11.2 on *A*, you have 24.1 acres on *B*. Here obſerve, that all irregular polygons are in the ſame manner divided into triangles; and the content of each found, and added into one ſum.

Regular polygons are diſtinguiſhed by the number of equal

ſides; thus a figure having 5 equal ſides and 5 equal angles, is termed a *pentagon*; a figure having ſix equal ſides is called a *hexagon*. The general rule whereby the ſuperficial content of any polygon is found, is this: Take $\frac{1}{2}$ the circumference, or the length of one ſide multiplied by $\frac{1}{2}$ the number of ſides, multiply this by the perpendicular falling from the centre of the figure on any of the ſides; the product gives the ſuperficial content. An example of paviours work.

Suppoſe a piece of pavement in the form of a regular hexagon, the length of the ſide 35 feet, the perpendicular 30.3 feet; required the area in ſuperficial yards? $35\times3=105$ the half circumſtance which $\times$ 30.3 gives 3181.5 this divided by 9 gives 353.5 yards, the anſwer. By the rule ſet 9 on *A* to 105 on *B*; and againſt 30.3 you have 353.5, the ſame anſwer.

The area of a circle is found by ſquaring the diameter, and multiplying the product by this conſtant factor .7854, which expreſſeth the area of a circle whoſe diameter is unity. Suppoſe a table round and circular, 5 feet diameter, required its area in ſquare feet? $5\times5=25\times.7854=19$ 635 feet, the anſwer; were it an oval table 6 feet long and 4 broad, the content would be $6\times4=24\times.7854=18.849$.

SECT. II. *Of Solids.*

SOLIDS are meaſured by the ſolid inch, foot, or yard. A ſolid or cubical inch is a body of a die figure, its length, breadth, and depth being 1 inch, 1728 of theſe inches, that is, $12\times12\times12$ make one cubical foot, and 27 cubical feet make one cubical yard. Alſo 282 ſolid inches make 1 gallon Engliſh ale-meaſure; 231 inches make 1 gallon wine-meaſure; 2150 inches are 1 malt buſhel; 40 ſolid feet make 1 tun of wood. Now, the ſolid content of every body is found by rules adapted to its particular figure.

Cubes and parallelopipedons are ſo called, becauſe they are contained under ſix ſurfaces, the oppoſite ones wherof are parallel and equal; and their ſolid content is found by multiplying the length by the breadth, and that product by the depth.

Exam. 1. Required in ſolid feet the content of a log equal at both ends, the length 16.5 feet, and 14 inches every way by the ſide; or, as carpenters term it, 14 inches ſquare. Firſt, ſquare 14, that is, $14\times14=196$, then ſay, as 144 inches to the length 16.5 feet, ſo is 196 inches to the anſwer in feet;

16.5

16.5×196=3234, which divided by 144 gives 22.46 feet. This and the like is readily performed by the ſliding rule; ſet 12 on the girt line marked *D*, to the length on *C*, then look for 14 on *D*, and oppoſite to it you have the anſwer on *C* 22.46: or by the gunter, extend your compaſs from 12 to 16.5, that diſtance twice turned over will reach from 14 to 22.4, as before.

Exam. 2. Required the content in malt buſhels of a cheſt 40 inches long, 20 inches broad, and 15 deep; 40×20=800×15=12000, which divided by 2150 inches in a malt buſhel, gives 5.581 the anſwer. By the ſliding rule firſt find a mean proportional between the length 40, and the breadth 20, which is 28.28. Then ſet 46.36 the gauge-point for malt marked on Everard's ſliding rule *M S*, on the line *D*, to 15 on *C*, and oppoſite to 28.28 on *D*. you have the anſwer on *C*.

Priſms of all kinds, whether ſquare, triangular, or polygonal, are meaſured by one general rule. Find the ſuperficial content or area of the baſe by the proper rule of ſect. 1.; this multiplied by the length or height of the priſm, gives the ſolid content. What is the content in ale-gallons of a triangular priſm, the triangular baſe whereof is 36 inches in the ſide, and 24 inches by the perpendicular falling on that ſide? The altitude being 40 inches, $\frac{1}{2}$ of 36=18×24=432×40=17280, this divided by 282 inches in one ale-gallon gives 61.27 gallons. Pyramids may be reduced to the ſame rule, being $\frac{1}{3}$ of their circumſcribing priſm.

The ſegments of pyramids, as are all ſquare logs greater at one end than at the other, are generally meaſured by carpenters in the following manner: Take the girt of the log in the middle, $\frac{1}{4}$ part of which note down; multiply it by itſelf taken in inches, then ſay, as 144 is to the length of the log in feet, ſo is that product to the content in feet *Example.* Suppoſe a ſquare log 60 inches round in the middle, and 24 feet long; required its content in ſolid feet; and how many tuns of wood are contained in 20 of theſe logs? Firſt, $\frac{1}{4}$ of 60=15, which ×15 gives 225; then 144 : 24 :: 225 : 37.5, the content of one log, which multiplied by 20 the number of logs, and divided by 40 ſolid feet in a tun of wood, gives the number of tuns required, 18 tuns 30 ſolid feet. By the ſliding rule, ſet 12 on the line *D*, to 24 the length in feet on the line *C*; and againſt 15 on *D*, you have the anſwer on *C* 37.5; or on the gunter extend from 12 to 15, that diſtance

doubled or twice turned over the ſame way reaches from 24 to 37.5. the content of 1 log in feet. Then to find the content of 20 logs in tuns, ſet 40 on *A* to 20 on *B*, and againſt 37.5 on *A* you have 18.75 on *B*.

A cylinder is meaſured by multiplying the ſquare of the diameter by .7854, and multiplying that product by the length. *Example.* Suppoſe an equal round piece of timber 14 inches diameter, and 5 feet long; what is its ſolid content? 14×14=196×, multiply by the length, taken in feet 196×5=980, and divide by this conſtant diviſor 183.34, which is a gauge point for ſolid feet in round timber ariſing from the diviſion of 144 by .7854, the quotient 5.345 gives the ſolid content of the piece in feet before the ſlobs are taken off.

By this rule all round timber, whether equal at both ends or not, is readily meaſured both by the pen and ſliding rule, the diameter in the middle being known.

Suppoſe a round log 15 feet long, and the circumference in the middle 66 inches, required its ſolid content in feet, before the ſlobs are taken off? Firſt, find the diameter by this proportion, as 22 : 7 :: 66 : 21. Square 21, that is 21×21=441, multiply by the length in feet, 441×15=6615, this divided by the above-mentioned point 183.34 gives the anſwer 36.08 feet.

By the ſliding rule, ſet 13.5 (the ſquare root of 183.34) found on the line *D*, to 15 feet the length on *C*, and oppoſite to 21 the diameter on *D*, you have the ſame anſwer on *C* 36.08; or becauſe it may ſeem tedious to find the diameter by the circumference, to ſhorten the work, ſay, as 42.54 a point is to 66 the circumference, ſo is the length 15 feet to 23.27 a fourth number; again ſay, as 42.54 is to 66 :: ſo is 23.27 to 36.05 the anſwer. Set 42.54 on *D* to 15 the length on *C*, and oppoſite to 66 the circumference on *D*, you have the anſwer 36.05 on *C*: or on the gunter, extend your compaſs from 42.54 to the circumference 66, that diſtance twice turned over the ſame way, from 15 the length, reaches to the ſame anſwer as before.

Caſk-gauging.

There are many different canons drawn from ſtereometry for the gauging of caſks; the following is both exact, and the moſt expeditious, by pen and ſliding rule: Take the dimenſions of the caſk in inches; namely, the diameter at the bung, the diameter at the top, and the length of the caſk; ſubtract the top diameter from the bung diameter, and note down the difference;

ference; if the ſtaves of the caſk are much curved and bulging between the bung and the top, multiply the difference by .7; if they do not bulge ſo much, multiply by .65; if they bulge yet leſs, multiply by .6; if they are ſtraight, or almoſt ſtraight, multiply by .55, and add the product to the top diameter; the ſum will be a mean diameter by which the caſk is reduced to a cylinder. Square the mean diameter thus found; then multiply by the length of the caſk. Divide the product by 359 for beer-gallons, or 294 for wine gallons.

Exam. 1. Required the content in ale gallons of a round hogſhead, the bung diameter 48 inches, the top diameter 36 inches, the length 60 inches?

Bung diam.	48
Top. diam.	36
Difference	12
×	.7
	8.4
Add the top diam.	36.0
The mean diam.	44.4
	44.4
	1776
	1776
	1776
Squared	1971.36
The length	60

For ale gallons 359) 118281.60 (329.47 ale gall.
1077
1058
718
3401
3231
1706
1436
2700
2513
187

By the ſliding rule.

On the line *D* you have 18.9 the gauge point for ale gallons marked *A G*. Set this to the length of the caſk 60 on *C*, and againſt 44.4 the mean diameter on *D*, you have the anſwer on *C*, 329.5 as above.

Exam. 2 Required the content in wine gallons of a pipe 36 inches by the bung, 26 by the top, and length 54 inches.

Bung diam.	36
Top diam.	26
Difference	10
×	.6
	6
Add the top diam.	26
The mean diam.	32
	32
	64
	96
Squared	1024
Length	54
	4096
	5120

Diviſor for wine 294) 55296 (188.08 wine gallons,
294
2589
2352
2376
2352
2400
2352
48

By the ſliding rule.

On the line *D* you have 17 the gauge point for wine gallons marked *W G*. Set this to the length 54 on *C*, and againſt 32 the mean diameter on *D*, you have the anſwer on *C* 188.08 as before.

The End of the FIRST VOLUME.